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Presence of a Hemorrhagenic Factor in Soybean Pellets when Fed to Cattle

Preliminary Report on the Field Use of Avianized Distemper Virus in 100 Dogs

Observations on the Clinical Effects of Injecting Procaine Hydrochloride into Domestic Animals

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Comparisons of Immunogenicity of Five Strains of Newcastle Disease Virus

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Effect Of Parasites On The Growth Of Pigs

LLOYD A. SPINDLER,* Sc.D.

SWINE are beset by numerous parasites, some species of which may occur wherever pigs are raised. Notable among these are ascarids, lungworms, whipworms, nodular worms, intestinal threadworms, stomach worms and certain protozoa. Others, such as kidney-worms, are generally confined to more or less definite regions. Still others, such as cystic tapeworms, flukes and linguatulids, are comparatively rare in this country, or have attracted little attention. Although quantitative evidence of the extent to which parasites can inhibit the growth of pigs is lacking in many cases, all (particularly the roundworms—nematodes) that inhabit the alimentary, urinary and respiratory tracts, should be considered as potentially injurious. Evidence favoring this view is gradually coming to light[1]. The purpose of this paper is to summarize briefly some of the information of this nature that has accumulated during the past few years.

Certain facts presented were obtained through observation of pigs experimentally infected with a single species of parasite. In other investigations, susceptible pigs were kept under conditions in which infections by several species were acquired naturally, various methods being employed to prevent some of the animals from acquiring severe parasitisms. To obtain a basis for an understanding of the facts presented, it is considered desirable to review the experiments from which facts were gleaned. In addition, in that portion of the discussion that relates to the effect of a single parasite, information relating to the prevalence of the parasite and its life cycle is summarized.

INFECTIONS WITH A SINGLE SPECIES OF PARASITE

The Large Intestinal Roundworm or Ascarid, *Ascaris lumbricoides* var *suis*

Prevalence. The adult stage of the large intestinal roundworm or ascarid occurs in the small intestine, and is the parasite best known to hog raisers. It is the largest and perhaps the most widespread of the parasites of swine. Probably most farm-raised pigs harbor at least a few of these at some time during their lives. Statistical data on the prevalence of ascarids in swine are scanty, but a few observations have been recorded. For example, Ransom and Foster[2] examined the intestines of more than 2,000 swine slaughtered in a meat packing establishment in the Midwest and found ascarids in 41%. Spindler[3] recovered ascarids post mortem from 74% of 348 swine that originated in the southeastern states. Andrews and Connelly[4] examined at slaughter 129 hogs raised on an experiment station farm in the Southeast and recovered ascarids from 68%. Allen and Jones[5] found ascarid eggs in the feces of 36% of 505 hogs examined prior to slaughter in a Midwest meat packing establishment; the hogs had originated in various states of that region. In addition, some investigators have estimated that about one-third of the swine breeding stock the country over may harbor these parasites. Owing to the indicated prevalence, and the fact that a single female ascarid may lay more than 250,000 eggs a day,[6] the soil of most hog lots and pastures is undoubtedly teeming with eggs, which assure infection of pigs kept in this environment.

Life Cycle. Ascarids of swine go through a highly complicated life cycle within the body. Eggs passed in the feces of an infected animal undergo a period of development on the ground and become infective in about a month. When swallowed by a susceptible animal, the eggs hatch in the small intestine, and the larvae, which are microscopic in size, penetrate the blood vessels and are carried first to the liver, then to the lungs. In the lungs, the larvae break out of the capillaries into the air spaces, through which they migrate to the esophagus and are swallowed. On reaching the small intestine, they become established and grow to sexual maturity in about six weeks. The life cycle of ascarids within the host may therefore be divided into three stages, namely; (1) the period during which the larvae are migrating through the internal organs, (2) the stage of growth and development of the parasites within the lumen of the intestine, and (3) the period of sexual maturity of the worms. The longevity of adult ascarids in the intestine is attested by the fact that infected swine maintained under conditions which precluded rein-

*Zoological Division, Bureau of Animal Industry, Agricultural Research Administration, U. S. Department of Agriculture, Washington, D. C.

fection continued to pass the eggs in their feces for as long as three years (unpublished observation).

Effect on Growth of Pigs

It has been long observed that ascarid-infected pigs often fail to grow at a normal rate, and it has been stated that the growth

Fig. 1. Effect of ascarids on the growth of pigs. Pig on left harbored 12 ascarids and at necropsy weighed 2.25 pounds less than uninfected littermate control on right.

of such infected pigs may be retarded to such an extent that it is impossible to get them into marketable condition early enough to be profitable[7]. Some investigators have considered that

Fig. 2. Effect of ascarids on the growth of pigs. Pig on right harbored 20 ascarids and at necropsy weighed 49 pounds less than uninfected littermate on left

the unthriftiness commonly associated with ascarid infections is primarily a result of injuries inflicted by larvae during their migration through the liver and lungs, and that the adult worms in the intestine are of comparatively little importance in this respect[8]. This idea is based, no doubt, on the fact that the condition known as thumps, a clinical manifestation associated with invasion of the lungs by large numbers of ascarid larvae, is often easily recognized, and that adult swine often harbor ascarids in the intestine without apparent ill effects. Recent investigations have indicated, however, that while invasion of the liver and lungs by ascarid larvae may be highly injurious, the presence of the adult parasites in the intestine may also be deleterious[9].

In these investigations, eight littermate weanlings, worm-free at the beginning, were kept in separate pens under conditions which precluded extraneous infection with ascarids and other roundworms. Four were fed infective ascarid eggs daily between the 14th to the 25th and the 32nd to the 38th days; the remaining four were not fed ascarid eggs and served, therefore, as controls. The pigs were kept under observation for about four months. They were then weighed, slaughtered and examined for parasites.

At necropsy, the number of ascarids harbored by the test pigs ranged from 12 to 109; the controls harbored none. Weight gains made by the parasitized animals during the experiment were inversely proportionate to the number of worms found post mortem, those most lightly infected making the greatest gains. Analysis of the growth rates in relation to the three stages of the life cycle of the worms aforementioned shows the following facts: (1) During the period ascarid larvae were migrating through the liver and lungs of the host, rather marked reductions in the growth rate of the animals occurred; (2) during the period the ascarids in the intestine were developing to sexual maturity, the growth rates of the infected pigs were approximately equal to those of the corresponding controls, indicating little deleterious effect by the developing worms; and (3) beginning at approximately the time the parasites became mature, as indicated by the appearance of ascarid eggs in the feces, a rather marked slowing down of the growth rate occurred. This slowing down of the growth rate, coincident with attainment of sexual maturity by the worms, indicates that an adverse effect on the health of the pigs was being exerted by the sexually mature parasites. The following brief discussion will serve to illustrate these facts.

One pig, at necropsy, harbored 12 ascarids. Its average daily gain during the experiment was 0.72 pound. This gain was not materially different from that of the corresponding control, which was 0.75 pound. At termination of the experiment, there was little difference in the appearance of the two pigs (fig. 1). This, coupled with the fact that, at necropsy, the two differed in weight by only 2.25 pounds, seems to indicate that the 12 ascarids had exerted little effect on the growth of the pig that harbored them. However, shortly after the first feeding of ascarid eggs, when the larvae were migrating through the liver and lungs, the affected pig lost weight to the extent that about two months after infection it weighed 20 pounds less than the control. At about that

time, 23 sexually mature ascarids were spontaneously eliminated in the feces. Within a few days after the worms were eliminated, the animal began gaining weight and during the remainder of the experiment grew more rapidly than the control.

Another of the infected pigs, which harbored 20 ascarids at necropsy, had made an overall daily gain of 0.39 pound during the test whereas the control, not being hampered by parasites, averaged 0.81 pound per day. The appearance of the two shortly before slaughter is shown in figure 2, the smaller being the infected one.

Following the first administration of ascarid eggs to the test pig, it lost weight during the period the ascarid larvae were migrating through the liver and lungs. From that time until the ascarids in the intestine attained sexual maturity, its growth rate was not materially different from that of the corresponding control. Beginning at about the time ascarid eggs appeared in the feces, there was an increasing divergence between the growth rate of the parasitized pig and that of its control. This indicates that the mature parasites were exerting a deleterious effect on the health of the pig that harbored them. At slaughter, the difference in weight of the two animals was 49 pounds.

A third infected pig harbored 39 ascarids at necropsy. Its average daily gain for the experiment had been 0.39 pound; the uninfected control averaged 0.81 pound per day. As with the other two, the gains of the parasitized pig were not made evenly throughout the test. For example, when the larval ascarids were migrating through the liver and lungs, loss of weight occurred. When the ascarids in the intestine were developing to sexual maturity, the growth rate of the parasitized pig was about the same as that of the corresponding uninfected control. When sexually mature ascarids were harbored, the gains of the parasitized pig were noticeably less than those of the control; the difference in weight of the two at slaughter was 53 pounds. The appearance of the two animals shortly before necropsy is shown in figure 3.

The fourth infected pig harbored 109 ascarids at necropsy. Following the first administration of ascarid eggs this animal had lost weight continuously and, shortly before necropsy, became moribund. At that time its weight was eight pounds less than at the beginning of the test. The companion pig, which was free of ascarids, had gained 0.76 pound per day, on the average. The difference in size of the two is shown in figure 4.

The Intestinal Threadworm, *Strongyloides ransomi*

Prevalence. Statistical data on the prevalence of intestinal threadworms in swine are scanty, but in a series of examinations of swine of all ages the parasite was found in 26%[8]. In view

Fig. 3. Effect of ascarids on the growth of pigs. Pig on left harbored 39 ascarids and at necropsy weighed 53 pounds less than uninfected littermate on right.

of the fact that older swine may develop a resistance to infection, the incidence is probably higher than indicated, since many adult hogs were included in the examinations[10]. Adult intestinal threadworms are among the smallest of the roundworms which infect swine.

Fig. 4. Effect of ascarids on the growth of pigs. Pig on left harbored 109 ascarids and at necropsy weighed eight pounds less than at beginning of the test. Uninfected littermate pig on right gained 0.76 pound per day during test.

When fully grown they are whitish, about one-sixth of an inch or less in length and often are embedded more or less deeply in the intestinal wall. Consequently, they may be overlooked in routine postmortem examinations. This fact may serve to account, in part at least, for the lack of specific information regarding the prevalence of threadworms in swine.

Life Cycle. Threadworms are peculiar in that no males have been found in association with females in the intestine of swine. Moreover, in the stages outside the body of the host, they may undergo a complex and unusual course of development on soil. Eggs produced by female threadworms in the intestine usually contain an embryo by the time they reach the exterior. In the feces, the microscopic eggs complete their development and hatch within a few hours.

The larvae follow one of two courses of development. Some develop within a few days to the infective stage. Others develop into free living males and females, so small as to be almost microscopic, which are not infective to

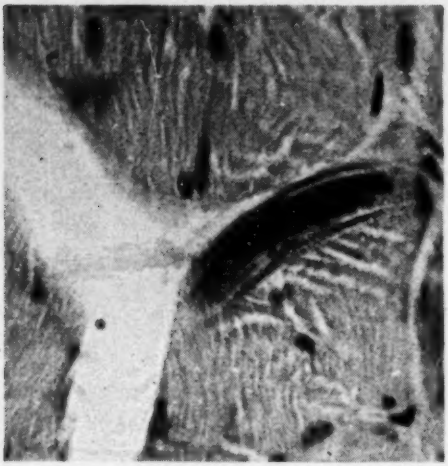

Fig. 5. Larva of intestinal threadworm, *Strongyloides ransomi*, in heart muscle of pig.

swine. In the latter case, the worms mate, and the females produce eggs, from which tiny larvae hatch and develop to the infective stage.

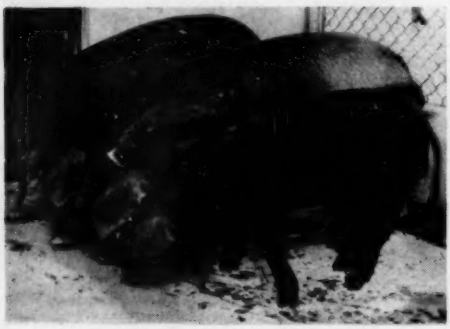

Fig. 6. Effect of intestinal threadworms on growth of pigs. Four months after the beginning of the experiment the weight of the infected pig in foreground was 135 pounds less than the average of the two uninfected pigs in background.

Pigs become infected with threadworms by swallowing the infective larvae along with feed and water, or as a result of penetration through the skin. Once within the body of the pig, the young threadworms invade all tissues including the brain and spinal cord, the reproductive organs, and the skeletal and heart muscles (fig. 5). Eventually the larvae reach the lungs and migrate through the air passages to the esophagus and are swallowed. In the small intestine they become established and grow to maturity in about a week.

Effect on Growth of Pigs

Recent investigations have shown that threadworms can severely retard growth[11]. In this work, littermates free of threadworms were housed in pens, the floor of which was covered with straw contaminated with feces of threadworm-infected pigs; the straw was kept moist at all times to permit development of the larvae. Littermates also free of threadworms were kept in uncontaminated pens, the floor of which was also covered with moist straw; the latter pigs remained free of threadworms and served, therefore, as controls.

Within 24 hours after the beginning of the experiment, the actions and appearance of the pigs housed in contact with the contaminated straw indicated that threadworm larvae were penetrating the skin. The animals tried to avoid contact with the straw by climbing into the feed and water troughs, the skin of the abdomen and legs became inflamed, and the pigs continually scratched and rubbed against the sides of the pen. Other symptoms developed later. These included loss of appetite, tenderness of the muscles, and diarrhea. The last-mentioned condition first occurred only at night but soon became continuous. As a consequence of the continuous diarrhea and failure to eat, the pigs lost weight, and all but one died about one month after the beginning of the experiment. Death was preceded by vomiting, high intestinal hemorrhage and evidence that the animal was in great pain. At necropsy, many adult intestinal threadworms were recovered from the small intestine, and threadworm larvae were recovered from the brain and spinal cord, liver, gall bladder, reproductive organs, and skeletal and heart muscles. The weight of the infected pigs at time of death was about one-third that of the controls.

None of the controls developed symptoms, none died and all remained free of threadworms as indicated by failure to find the eggs in their feces.

Four months after the beginning of the experiment, the parasitized pig which survived weighed 135 pounds less than the average of the controls. The small size of this parasitized animal as compared with that of the controls is shown in figure 6.

The pathogenicity of intestinal threadworms is further illustrated by the fact that numerous cases of sudden death of young and adult swine in the herd of the Zoological Division

at Beltsville, Md., and a number of deaths of farm-raised pigs in Maryland have been found associated with extensive invasion of the entire body, particularly the heart and skeletal muscles and the brain and spinal cord, by migrating larvae[11,12,13].

NATURALLY ACQUIRED INFECTIONS WITH SEVERAL SPECIES OF PARASITES

In an investigation carried out at Beltsville, Md., three groups of weanling littermates, worm-free at the beginning, were maintained on hog lots that for a number of years had been occupied by swine harboring infections of most of the roundworm and protozoan parasites common to swine[14]. One group, the controls, was fed a balanced grain ration and was in no way protected against parasites. The other two groups were kept relatively free of parasites by feeding skim milk. In one group, the milk was given in lieu of grain and water for three consecutive days at intervals of two weeks. The other group was given the milk in lieu of grain and water once daily. When milk was fed, the pigs were supplied with all they would drink; at all other times they were fed adequate amounts of the balanced grain ration. Observations were continued for about three months. During that time, the group which was fed only grain and was, therefore, unprotected against parasites, acquired heavy infections of ascarids, whipworms, lungworms, stomach worms and coccidia. As a consequence of the heavy parasitism, these pigs gained only 0.32 pound per day, on the average. Their unthrifty condition (fig. 7) was reflected in an inferior condition of the carcasses at slaughter, characterized chiefly by small size and lack of fat (fig. 8).

In contrast, those fed milk either remained free of parasites or acquired light infections of a few species, and gained 1.01 pounds per day, on the average. The thrifty condition of these pigs is illustrated by figures 9 and 10.

That the superior weight gains of those fed milk was a result of freedom from parasites is shown by the following experiment[15]. Three groups of roundworm-free, littermate pigs were kept on clean ground and fed milk and grain according to the regimen described above. Those fed milk made an average daily gain of 1.22 pounds, and the group fed grain only gained 1.15 pounds per day, on the average. These growth rates approximated closely the growth rate of pigs which, in the experiment described above, were kept on worm-infested soil and at the same time were protected against parasites by frequent feedings of milk. Furthermore, the weight gains of the group fed grain as the sole constituent of the diet were superior to those made by pigs kept on contaminated soil and fed only grain and which, as a consequence, acquired heavy parasite loads. These facts also attest to the injuriousness of parasites.

Further evidence of the effect, on growth, of naturally acquired infections of several species of parasites is afforded by observations made

Fig. 7. Effect of several species of parasites on the growth of pigs. These pigs were heavily infected with intestinal helminths and made an average weight gain of 0.32 pound per day. Note stunted, rough appearance.

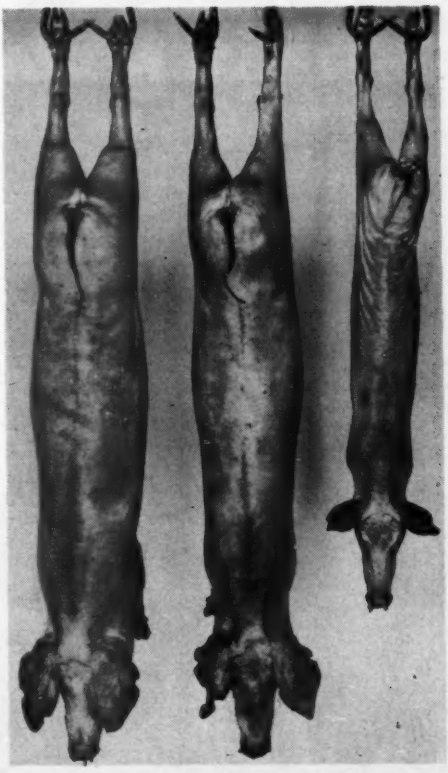

Fig. 8. Carcasses of pigs in fig. 7. Note small size and lack of fat.

by parasitologists of the Bureau of Animal Industry in Georgia during 1941 to 1949[16]. In the investigations, litters were farrowed each fall and spring under conditions conducive to the acquisition of moderate to heavy infections with most of the internal parasites occurring in swine in the coastal plain area. Equal numbers of litters were farrowed each year under conditions designed to limit to a large extent the acquisition of parasites. The growth of pigs that acquired moderate to heavy infections was retarded to the extent that they required from four to five weeks longer to attain a weight of 225 pounds than did those lightly infected.

Fig. 9. Pigs constantly exposed to parasites and protected against infection by frequent feedings of skim milk in lieu of grain and water. Compare with fig. 7.

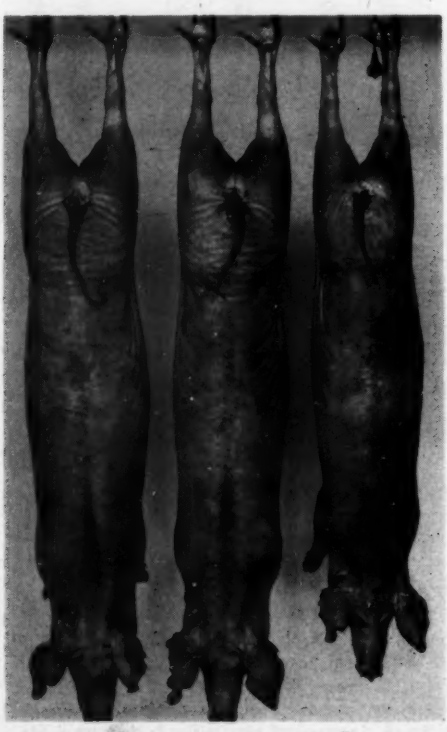

Fig. 10. Carcasses of pigs in fig. 9.

Discussion and Conclusions

In spite of the injuriousness of parasites, swine raisers often take little note of them and apparently fail to recognize their importance. This indifference may stem in part from the fact that in the past there has been available relatively little quantitative information as to the exent to which parasites can inhibit the growth of pigs. In addition, it is a fact, well recognized by parasitologists, that in sublethal infections the effect of parasites may not become apparent for some time and, in many cases, may not be recognized at all since, generally, all or nearly all of the animals in a herd are likely to be parasitized at one time, and the element of contrast is, therefore, lacking. Consequently, since parasitic diseases, unlike bacterial and virus diseases, are usually of an insidious nature, the pigs being neither sick nor well, parasitism may be overlooked as a cause of unthriftiness. It is only when the concentration of infective stages in the environment becomes so great that fatal infections occur that parasitism becomes apparent to the casual observer.

Almost invariably pigs are exposed to repeated contacts with the infective stages of at least some of the parasites that infect swine. On most farms, the hog lots, farrowing houses, barns and pastures, through long-continued use by swine afflicted with varying degrees of parasitism, have become seeded with the infective or transmitting stages of parasites. The extent to which contamination can occur is illustrated by the fact that literally thousands of parasite eggs and larvae have been recovered from as little as an ounce of soil collected from a permanent hog lot. Eggs of ascarids, lungworms and thorn-headed worms are capable of surviving on soil for long periods of time[17,18,19,20]. As a result of this longevity, a cumulative action occurs when the soil is repeatedly contaminated with the droppings of animals harboring these parasites, and the longer the contamination continues the greater is the concentration of the eggs that will ultimately result, within certain limits at least.

It is practically inevitable, therefore, that pigs farrowed and raised on premises in constant use for swine will swallow each day numerous eggs of ascarids and whipworms, larvae

of nodular worms, kidneyworms, and red stomach worms, and the larval stages of lungworms, spirurid stomach worms, gullet worms, and thorn-headed worms. These larval stages are contained in the bodies of various arthropod and annelid intermediate hosts, of which pigs are fond. That parasites may be acquired by pigs early in life is shown by the fact that experimental litters farrowed and kept in filthy hog lots acquired infections of various parasites as soon as two days after birth[21]. Every parasite that becomes established in the body of a young pig takes its toll of the health and vitality of its host.

In spite of the insidious and little recognized nature of parasites, losses caused by them may constitute the difference between profitable and unprofitable swine production. When it is necessary, because of parasites, to extend the feeding period of a herd of pigs as much as five weeks to bring the animals to a satisfactory market weight, or when losses of as much as 50 pounds in some animals are sustained because of parasites, the situation becomes serious. Such losses are a high price to pay for harboring pests which can be controlled at least partially.

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The Presence Of A Hemorrhagenic Factor In Soybean Pellets Extracted With Trichloroethylene As A Solvent When Fed To Cattle*

(A Preliminary Report)

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This report, attributing extensive death losses in a large herd of feeder steers to a hemorrhagenic factor contained in soybean oil meal (pellets), is of especial significance considering the widespread use of this vegetable protein feed.

Soybean oil meal from which the oil has been extracted with trichloroethylene solvent has been used as a feeding supplement for some years in beef cattle feeding operations, in dairy rations, and as a swine supplement. Its popularity among livestock feeders has increased rapidly because of its excellence as a source of protein. This supplement has been considered safe because the minute quantities of trichloroethylene remaining in the meal have proved non-toxic. Feedings at high levels over an extended period have been shown to be fatal in a controlled experiment. The toxic factor(s) has not been determined. It is suggested that this is developed in the pellet by combination with complex protein molecules.

INVESTIGATION of death losses in a herd of cattle which had been fed soybean pellets and native pasture (bluestem, etc.) or baled, bluestem hay during inclement weather, led to this project.

Symptoms Exhibited

The symptoms observed chiefly were those of extensive hemorrhage, a marked anemia and slight icterus, particularly when animals survived for a period of five to ten days. Some of these animals died within 72 hours following appearance of first visible symptoms while a few lived for approximately three weeks. Initially observed was a slight hemorrhage from the nostrils; bleeding gradually increased as the condition progressed. In the initial stages, animals continued to eat and did not appear ill in any way, except for nasal hemorrhage which was exaggerated after exercise or handling. There was no increase, or only a slight elevation, in temperature in the early stages. Temperatures of 105 to 107.6 F. were observed in the terminal stages. Elevated temperatures were recorded in animals that sickened suddenly and died within 72 hours. In these, rectal temperatures were recorded as high as 107.6 F.

In the late stages of the disease process, blood or blood clots appeared in the feces. Petechial and ecchymotic hemorrhages were present on the conjunctiva and the membrana nictitans, as well as the mucous membranes of the mouth, particularly the buccal surface of the lower lip. These hemorrhages were also present in the subdermal layers of the skin, particularly the scrotum and in other non-pigmented areas.

Hemoglobinuria was not observed in any of these animals. A characteristic thick seromucous discharge, tinged with blood, was observed hanging from the nostrils in the subterminal and terminal stages. Animals at this stage usually were down the greater portion of the time. Respiration was increased (70) and the pulse usually was rapid and irregular (90-120). Dehydration increased as the symptoms progressed; the animals became weak, exhibiting a marked depression just prior to death.

Postmortem Lesions

On autopsy, the principal lesions observed were those of extensive hemorrhage. Petechial and ecchymotic hemorrhages were present in the subdermal layers of the skin extending into the muscle tissue. Some of the animals presented large hematomas over the back and flank regions.

The small and large intestines, omasum, and abomasum, revealed innumerable large and small hemorrhagic blotches on the serous surfaces. The mucosa of the small intestine

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contained multiple areas of focal necrosis and hemorrhage. The necrotic lesions, in many instances, appeared as raised concentric areas.

The longitudinal folds of the abomasum were greatly thickened, and edematous. Numerous ecchymotic hemorrhages were noted.

The spleen presented many subcapsular hemorrhages in most cases.

Livers were somewhat enlarged, the surfaces covered with ecchymotic and petechial hemorrhages. Upon incision, these also were numerous throughout the parenchymal tissue. Hemorrhagic infarcts were observed in the liver as well as many large areas of necrosis. The necrotic foci were marked and very extensive in all cases. These foci appeared light in contrast with the normal surface of the liver. The gall bladder presented small and large ecchymoses on the serosal and mucosal surfaces.

The kidneys, in all instances, presented a profusion of petechial hemorrhages which extended through the cortex; fewer were noted in the pelvis. No apparent swelling of these organs was noted.

The heart in all cases contained petechial and ecchymotic hemorrhages, particularly around the base and the longitudinal grooves. Epicardial and subendocardial hemorrhages were observed. In no case were the heart valves involved.

In some cases subpleural hemorrhages were observed, but in no case was there any evidence of pneumonia.

The synovial fluid in all large joints was tinged with blood, and many contained blood clots.

The outstanding hematological laboratory findings were: a marked leukopenia, with almost complete absence of granulocytic cells (the remaining white blood cells were lymphocytes, particularly the large type); a marked anemia, except in very acute cases, with anisocytosis and hypochromia occurring during the terminal stages; basophilic stippling and nucleated red blood cells were observed in the latter stages in some animals; the blood hemoglobin was reduced from a normal of 10-12 gm. to 3.5-7 gm. per 100 cc. of blood; and the blood clotting time was delayed in all stages and became pronounced toward death in all animals.

Experimental Investigation

The possibility of an infectious agent, as well as plant poisoning, was eliminated in the early study of this outbreak by careful investigative procedures. It was apparent that the causative factor was present in the feed; therefore a feeding project was undertaken to establish the etiological agent.

Two apparently normal Holstein bull calves, each weighing approximately 400 lb., were purchased locally, and were fed a ration consisting of soybean pellets obtained from the ranch sustaining the losses, good average quality, baled, prairie hay, and salt. Hay was grown in the vicinity of Manhattan.

The two calves were started on the above ration on April 9, 1951, and by the end of 30 days the calves were receiving 3.5 lb. of pellets twice a day, prairie hay *ad lib.*, and salt. This ration was maintained throughout the experiment. The calves were kept in a screened box stall and were turned into dry lot twice a week for a short period for exercise.

In another experiment beginning three months earlier, four lots of two calves each were placed on prairie hay from the same source and a concentrate of linseed meal, and salt. This is still in progress. In addition approximately 20 other calves and cows were fed the same prairie hay from the same source as part of their ration previous, during, and subsequent to this project. We therefore feel that adequate controls were provided for the prairie hay.

Stockman[1] reported losses in cattle by feeding on meal from soybeans after extraction of the oil.

Calf no. 1 failed to eat the pellets on the morning of July 7, 1951, three months after the feeding trial was begun. This animal suddenly became ill, appeared gaunt, and slobbered at the mouth. The respiration was rapid (70) and the pulse fast (100). Close observation revealed a rust red discharge from the nostrils, and small petechial hemorrhages on the inner surface of the lower lip and ventral portion of the tongue and conjunctiva. Large petechial hemorrhages were also present in the subdermal layer of the skin on the scrotum. The temperature of the animal was 107.8 F. Examination of blood sample revealed: R.B.C. 7,240,000, W.B.C. 4,050, hb. 9.3 gm., lymphocytes 93%, polymorphs 7%.

The following day (July 8) symptoms noted were: marked depression, animal failed to eat or drink and appeared "slabsided" and gaunt. Innumerable hemorrhages were observed in the eyes, on the mucous membranes of the mouth, particularly the inner surface of the lips and subdermal layers of the skin over the scrotum and abdomen. There was considerable blood seeping from the nostrils and slobbering at the mouth. Temperature 106.5 F., R.B.C. 7,590,000, W.B.C. 1,800, hb. 9.2 gm., lymph-

ocytes 96%, polymorphs 4%.

Symptoms (July 9): Animal was greatly depressed with head hanging down, and drooling from the mouth. A thick seromucous discharge tinged with blood was observed hanging from the nostrils. The animal appeared very weak and "wobbly." The four feet were placed close together with the back arched. Feces were thick and slightly discolored with blood. Blood failed to clot for eight hours from a small lancet puncture in the ear. Temperature was 104.8 F. The animal ate no feed or water and was dehydrated. Clotting time of the blood and prothrombin time were delayed. A solid blood clot was not formed until one hour and 40 minutes after bleeding. R.B.C. 7,530,000, W.B.C. 1,150, hb. 8.6 gm., lymphocytes 98%, polymorphs 2%.

The hemorrhaging from the nostrils became quite profuse when this animal was handled. Death occurred on the third day of illness (July 9) and autopsy was performed immediately.

Autopsy Lesions

Skin. The deeper layers revealed hemorrhagic blotches and ecchymotic hemorrhages. The carcass, too, was covered with the same type of lesion extending into the deeper muscle layers. There were several subcutaneous hematomas 2 in. x 3 in. and ¾ in. deep in the lumbar and upper flank region. There was no apparent predilection in the distribution of hemorrhages as they were observed more or less over the various parts of the body. There was a thin layer of diffuse, subcutaneous hemorrhage in the scrotum.

Large areas of hemorrhage beneath the peritoneum in the sublumbar region were noted in the abdominal cavity. One of the hemorrhagic areas measured 5 in. by 7 in.

Bladder. There was no discoloration of the urine, but there were small subserous hemorrhages.

Small Intestines. Innumerable small and large hemorrhagic blotches appeared on the serous surface, and a copious, dark, bloody fluid was present in the lumen. Necrotic and hemorrhagic foci were profuse over the mucosa.

Large Intestines. The contents, particularly of the cecum, were watery. A large quantity of dark blood was present. Large blood clots and blood were present in the lumen of the large intestines, and there were a few necrotic areas present on the mucosa. There were more hemorrhagic areas on the serosal surface than on the mucosal surface of both the small and large intestines. The mesentery and omentum contained petechia and ecchymosis, and a yellow, gelatinous exudate was observed along the border of the mesentery. The lymph nodes of the mesentery were hemorrhagic and edematous, but not noticeably swollen.

Rumen. Several hemorrhagic blotches were scattered over the parietal and dorsal surface of the rumen. No gross changes were observed on the mucosal surface. A considerable amount of ingesta was present.

Reticulum. No gross changes were observed in the reticulum.

Omasum. The entire parietal surface of the omasum was covered with diffuse hemorrhage; its contents were dry and firm. A few hemorrhagic areas and small blood clots were observed on the laminae omasi. A gelatinous exudate was present at the neck of the omasum on the serosal surface.

Abomasum. A large hemorrhagic area (2½ in. x 4 in.) was noted on the right or parietal surface of the abomasum, and its contents contained some blood and a few small blood clots. The mucosa was greatly thickened, edematous, and hemorrhagic, particularly the longitudinal folds. Small, necrotic areas were observed in the pyloric portion.

Spleen. Subcapsular hemorrhages were present on the parietal and visceral surfaces of the spleen. There was some evidence of atrophy.

Liver. The entire surface of the liver was covered with multiple subcapsular hemorrhages with necrotic areas throughout the organ which appeared light brown in color and varied in size up to one inch in diameter. Some of these areas appeared roughened and raised above the surface and upon incision were found to be undergoing necrosis. The gall bladder appeared as a hemorrhagic mass on the serous surface, with a number of diffuse ecchymoses on the mucosal surface.

Kidneys. The kidneys revealed diffuse subcapsular hemorrhages. The cortical portion was studded with petechia, and ecchymotic hemorrhages were present in the pelvic portion. The kidneys did not appear swollen or atrophied.

Thoracic cavity. There were huge blotches of hemorrhage beneath the visceral pleura, and the costal pleura also showed diffuse patchy hemorrhages. Numerous, subpleural, ecchymotic hemorrhages were present on the lungs, and a large, hemorrhagic infarct was observed on the dorsal border.

Heart. There were large areas of punctate and ecchymotic hemorrhages over the base of the heart, which extended down the right and

left longitudinal grooves, and numerous subepicardial and subendocardial hemorrhages were observed. The heart was dilated; no gross changes were observed on the valves.

The nasal turbinates were highly congested and many ecchymotic hemorrhages were present.

The yellow bone marrow contained numerous ecchymotic hemorrhages. The fluid in the large joints was tinged with blood and contained blood clots.

Discussion

It is evident that the prairie hay was not responsible for the losses observed in the large herd referred to as no abnormalities were observed in the calves and cows which were receiving other concentrates with the same hay.

It is apparent that animals must consume the protein feed at a relative high level and over a fairly long period before this hemorrhagenic factor manifests itself.

The degree of susceptibility apparently varies with individual animals. The second calf on this experiment remained apparently normal and is being continued on the same ration. Further blood studies and histopathological findings will appear in a later report.

Conclusions

The most striking feature of this clinical entity is that of hemorrhage and necrosis. The syndrome observed in the calf fed the experimental ration compares identically to the cases observed in the field that had been fed soybean pellets, prairie hay, and salt.

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The bactericidal action of the quaternary ammonium compounds, according to reports in current publications, seems to be influenced by a variety of things and conditions. As examples of this, it is recorded that they are incompatible with soap, and that calcium and magnesium hardness of water greatly reduces their efficiency, though in these latter instances the addition of alkaline detergents will again increase their bactericidal effectiveness. The advantages of the "quats" are that they are very soluble in water, and that they are tasteless and colorless; they are only feebly toxic, and corroding action on metals and rubber is practically nil. A very important point in their favor is that their germicidal action is only interfered with to a minimum by organic matter.

Effective Prophylaxis Against Infectious Canine Hepatitis

A series of experimental trials by veterinarians of Ashe Lockhart, Inc., Kansas City, Mo., have indicated the value of canine distemper antiserum produced by the Lockhart Laboratories as a prophylactic agent against infectious canine hepatitis.

With the development of new knowledge concerning the widespread prevalence of hepatitis, it was reasoned that animals hyperimmunized for the production of canine distemper antiserum might also develop a protective titer of antibodies against infectious hepatitis. In this work, a number of lots of serum produced by Ashe Lockhart, Inc. during 1949, 1950, and 1951 were tested. No attempt was made to hyperimmunize dogs with the virus of hepatitis.

In the first 18 litters of susceptible pups under test, distemper antiserum and a challenge dose of infectious hepatitis virus obtained from an acute field case were given simultaneously in different injection sites. In later tests, on an additional six litters, the serum dose was administered followed by the challenge virus in 24 hours. Litter mates served as controls. The complete report, prepared in pamphlet form for distribution to veterinarians, covers a total of 15 litters of puppies, comprising 67 dogs.

Interpretations of results were based on deaths and survivals and weight loss or gain only. All animals lost were examined for gross lesions. Study of protocols indicates that the serum under test gave good protection in doses of 0.25 cc. and 0.5 cc. per lb. body weight. All pups receiving these dosages of serum survived and gained weight, while litter mates died or lost weight as a result of virus inoculation. Since these lots of serum were selected at random from that produced during three calendar years it is concluded that all produced under the identical conditions and rigid schedules by the methods employed would be equally effective.

Clinical observations of interest made by Dr. Glen L. Dunlap during these trials include that susceptible pups die in three to six days with an acute fulminating type of disease process. Weight loss is slight and symptoms are exhibited for only a few hours. Animals that are resistant usually develop elevated body temperature and inappetence and lose weight rapidly. In these, there is no evidence of discharge from eyes or nose. Corneal opacity, if it occurs, appears in seven to 14 days postinoculation and is transient.

Preliminary Report On The Field Use Of Avianized Distemper Virus In 100 Dogs

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FOLLOWING the work of Laidlaw and Dunkin, vaccines for immunization against canine distemper became available in the early 1930's. The Laidlaw-Dunkin method of immunization,[1] *i.e.*, chemically inactivated vaccine followed by live virus, has been effectively used since that time, as have other methods such as the use of vaccine alone, and the simultaneous use of serum and virus. These methods have proved to have limitations in practice, and have led to continuous research for improved immunizing agents. Live virus vaccine[2] prepared from canine distemper virus serially passed in ferrets, has been reported to be an effective agent, but subsequent findings have shown that the virus is, on occasion, pathogenic for some dogs.

Attempts to modify the virus of canine distemper by adaptation to a foreign host have been made by several investigators[3,4]. In 1948, Haig[5] reported the successful cultivation of Green's virus in the developing chick embryo. This strain of virus was found to be only partially attenuated for the ferret and was still pathogenic for this animal. In 1949, Cabasso and Cox[6] reported the adaptation and modification in the developing chick embryo of a strain of virus used for the production of vaccine and virus for the Laidlaw-Dunkin method of dog immunization. This chick embryo-adapted strain, passed serially through embryonated eggs, became modified between the 24th and 28th egg passage. Ferrets inoculated with this material showed no signs of illness but were found to be immune on challenge with fully virulent, ferret-spleen virus.

This paper is concerned with this canine distemper virus (modified) avianized®. A single subcutaneous injection of this modified virus confers solid immunity. It is truly modified since it is not pathogenic and is not transmissible from ferret to ferret or from dog to dog. It can be administered to young dogs which have lost parental immunity. Postvaccinal reactions such as high rise in temperature, inappetence, and malaise are lacking, and there is little or no local tissue reaction or pain on injection. According to tests in ferrets, there is induced solid immunity eight to ten days following vaccination[7]. Challenge of chick embryo modified virus-immunized ferrets 14 months postvaccination showed them to be solidly immune.

Clinical Use

Avianized distemper virus has been used in the immunization of 100 distemper-susceptible dogs under ordinary field conditions. Animals vaccinated included those presented at the hospital for immunization purposes, as well as litters vaccinated in kennels under our care. In all cases, no other type of distemper immunization had been administered previously. The general physical condition of the animals selected varied from fair to excellent. Heavily parasitized dogs were treated before vaccination, but there was no attempt to correct moderate to light infestations prior to administration of the vaccine.

The nutritional background of these cases was typical of that encountered in small animal practice, varying from poor to good. Recommendations were made to correct marked nutritional deficiency, but vaccination was postponed only in those whose general condition was classified as poor.

Every effort was made to avoid the vaccination of dogs that had previously been infected or had been exposed to distemper. Animals with a history of any previous febrile disease were not included in this series. At the time of vaccination, temperatures in the normal range were generally recorded.

Results

Practitioners are especially interested in any postvaccinal reactions when a live virus, modified or otherwise, is used in the immunization procedure. Clients have a pronounced tendency to blame the agent injected and the veterinarian for any and all upsets occurring one to three weeks following any inoculation. Because of this, and the mild to severe undesirable reactions encountered in the past with many

®Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

products, the authors were quite interested in trials with this new preparation.

There was not a single undesirable reaction traceable to the vaccine in the entire series. All dogs were examined on the fifth, sixth, or seventh postvaccinal days. The temperatures of the majority were in the normal range, 101-102 F., as shown in table 1. Careful interrogation of the owners at the time of examination, regarding attitude, bowels, and appetite, disclosed nothing significant as concerned departure from the dogs' usual habits. A few clients mentioned a slight lassitude, lasting 12 or more hours, but no significance was placed on this observation. Several animals were presented with a history of vomiting and diarrhea in the first and second weeks after vaccination, but in each case, causes other than reaction from vaccination were determined.

In approximately 24% of the cases, where it was possible to get reliable client cooperation, temperatures were taken two and three times daily for seven days starting the day after vaccination. Temperature elevations ranging from 0.4 to 2.5 degrees above the individual's usual normal rectal temperature were detected in a few cases. These supposed reactions were quite transient, often lasting only five to eight hours. Most animals showed insignificant or no temperatue elevations during this seven-day period. It is felt that, inasmuch as temperatures were not taken during the night, and often eight hours elapsed between the daytime temperature readings, many mild febrile reac-

TABLE 1. Vaccination of 100 Susceptible Dogs with Avianized Distemper Virus

Group No.	No. Dogs	Breed	At Vaccination: Age Mo.	At Vaccination: Condition	At Vaccination: Temp.	Remarks
Postvaccination exposure to clinical cases of distemper or in distemper wards						
I	8	English Setters (kennel)	4¼	Poor	N.	Originally litter of 10; 2 died hookworm infestation. All debilitated at vaccination. Temp. twice daily for 7 da.; elevations* of 0.5-1.5 in 3 dogs—longest duration 12 hr. Exposure 3 mo. following vaccination.
II	18	Various breeds (hospital)	2¼ to 7	Poor to good	N.	Lassitude 1 day in 1 dog. Temp. elevation* to 102.2 in 3 dogs.
Postvaccination exposure to hardpad disease						
III	8	Golden Retrievers (kennel)	4	Excellent	N.	Temp. twice daily for 7 da.; 2 dogs showed elevations* between 0.5 and 2.5. Exposure to hardpad approx. 3 mo. postvaccination—none contracted disease.
Possible postvaccination exposure to distemper						
IV	7	English Setters (kennel)	3½	Fair	N.	Temp. 3 times daily for 7 da.; elevations* 0.4-2.4 in 4 dogs—longest duration 9 hr. Moderate hookworm infestation.
V	8	Various breeds (hospital)	3½ to 5	Fair to good	N.	Temp. of 102.2 in 4 dogs*. Each of 2 dogs shown at 3 dog shows. 2 puppies sent into homes which had had distemper cases 7 to 10 da. before. 1 dog—heavy roundworm infestation.
No known or suspected exposure						
VI	8	Coon Hounds (kennel)	3½	Excellent	N.	Temp. every 4-5 hr. during day for 7 da.; 5 showed temp. elevations* of 0.5-2.5—longest duration 8 hr.
VII	7	Coon Hounds (kennel)	3½	Good	N.	Temp. 3 times daily for 7 da.; 0.4-1.8 elevations* in 4 dogs—longest duration 14 hr.
VIII	36	Various breeds (hospital)	2¼ to 9	Poor to excellent	N.-34 102.2-1 102.4-1	At vaccination, heavy tapeworm, roundworm, or hookworm infestation in 3 dogs. Temp. elevations* to 102.2 in 3 dogs, to 102.4 in 1, and to 102.5 in 1. One dog not returned for examination.

N.—Normal.

*Temperature elevations (degree above normal rectal temperature) on examination on 5th, 6th, or 7th day.

tions of four to eight hours' duration went unnoticed. In none of these cases, where a transient temperature elevation occurred, were any other objective symptoms seen, except, perhaps, mild lassitude.

Exposure and Immunity

Many cases have been observed for more than nine months. To date, there have been no breaks reported in the entire series. Contact is being maintained with the majority of cases.

Postvaccinal exposure in distemper wards or to dogs with clinical symptoms of distemper was established in 26 cases. A satisfactory degree of immunity was present in all cases as evidenced by the failure of any of the vaccinated dogs to show any clinical symptoms attributable to distemper. It is interesting to note that three months after vaccination, eight Golden Retrievers were kenneled with a dog having a typical case of hardpad disease for approximately 25 days. None of the vaccinated dogs contracted the disease. The animal showing symptoms of hardpad disease had been vaccinated by another method.

An additional 15 vaccinated dogs were maintained under conditions particularly favorable for transmission, and where there was considerable chance for exposure. For the purposes of this report, these have been classified as "possible" exposure cases. The seven English Setters in group IV in the accompanying table are a good example of those included in this classification. These dogs were trained in Canada and in the South for five to seven months following vaccination. Their training necessitated much travel under poor conditions and frequent housing where there was contact with a large number of transient dogs. Dogs exhibited at two or more bench shows, and those hospitalized for three or more days are also included in this list. Two puppies which were vaccinated and sent into homes which had had distemper cases seven to ten days before were also termed possible exposure cases.

Summary and Conclusions

One hundred distemper-susceptible, previously unvaccinated dogs were vaccinated with avianized distemper virus. Animals selected were representative of the usual cross-section seen in everyday small animal practice, whether or not in good nutritional state or free of parasites. However, visibly sick dogs were not vaccinated.

No undesirable postvaccination reactions were encountered in any case. Slight febrile reactions of short duration may be encountered within the first week after vaccination, but many are missed unless temperatures are read four times daily. Twenty-six per cent of the dogs had postvaccination exposure to clinical distemper cases or in distemper wards. Eight per cent of those vaccinated were exposed to a typical case of hardpad disease without showing symptoms during a prolonged observation period. An additional 15% were maintained under conditions which, by past experience, were particularly favorable for transmission. Not a single break is known to have occurred.

Our experience indicates that the chick embryo-adapted virus of canine distemper is a safe, effective product for the immunization of unexposed dogs. Some evidence is presented to show that, with the establishment of immunity against distemper, they are also refractory to so-called hardpad disease.

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New Antibiotic, Fumagillin, Found to Have Exceptional Amebacidal Activity

Fumagillin, a new antibiotic, designated antibiotic H-3, first isolated from *Aspergillus fumigatus* has been shown to have direct amebacidal action *in vitro* and *in vivo**.

Level of toxicity for *Endamoeba histolytica* was found to be in dilution of 1:10,000,000 or higher. Field trials in treatment of naturally affected monkeys proved successful; no recurrence after from four to 14 weeks following oral treatment of five days' duration.

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Miscellaneous Observations On The Clinical Effects Of Injecting Solutions And Suspensions Of Procaine Hydrochloride Into Domestic Animals*

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DESPITE its wide usage, information on the side-actions of procaine hydrochloride is scant. Clinical observations suggested that the amounts of procaine hydrochloride often used in routine "firing" in horses produced some stimulation of the central nervous system. Herein reported are numerous observations on the clinical effects of injecting from moderate to large amounts of procaine hydrochloride in solutions and suspensions into the horse, cow, pig and dog.

Toxic Effects of Solutions Injected Subcutaneously

a. *Horse.* Table 1 shows the results of ten trials with four horses. The solutions ranged in concentration from 2 to 4% except in trial no. 10 where a 7.3% solution of procaine hydrochloride in sterile, distilled water was employed. A Shikles syringe was used to effect rapid subcutaneous injection. The clinical response of the horse to the injection of excitant amounts of procaine hydrochloride was clearly the result of excessive stimulation of the central nervous system. The general behavior of the horses receiving from 5 to 10 mg. per lb. body weight resembled that of a horse that had been doped or "hopped" for increased performance on a race track. The injection of 5 mg. per lb. caused nervousness in an otherwise quiet animal, which was manifested by frequent tossing of the head and tail, constant twitching of the ears, and a shifting and stamping of the feet. Injecting 10 mg. per lb. increased the vigor of the above reactions and also caused a neighing and snorting, moderate dilation of the iris, constant movement with prancing steps, generalized fine muscular tremors, and profuse sweating of the skin over and adjacent to the injected area.

Larger dosages of procaine hydrochloride resulted in defective locomotor coordination as shown by stumbling, weaving and progressive weakness in the rear quarters. There was much rubbing of the nose as if to appease an intense itching. A dosage of 40 mg. per lb. in trial no. 10 led to a stilt-like gait from which the horse sat down and then fell to its side, followed by several brief convulsive seizures. The next hour and a half were occupied by the continuous and finally successful struggle of the horse to regain its feet despite the inability of the skeletal muscles to function properly.

TABLE 1. Occurrence of Excitement in Horses Following the Subcutaneous Injection of Procaine Hydrochloride Solutions

Trial No.	Dosage mg./lb.	Signs of Excitement		
		Appearance (min.)	Duration (min.)	Unusual movements
1	3	none	none	none
2	5	20	25	±
3	10	16	50	+
4	10	18	45	+
5	10	15	60	+
6	10*	20	60	+
7	15	10	55	++
8	16**	3	65	++
9	20	16	92	+++
10	40	3	130	down

*Chloral hydrate solution orally 13 minutes earlier —4.5 gm./100 lb.

**Stronger concentration injected; 40 mg./lb. intended but not injected.

Premedication with chloral hydrate, 4.5 gm. per 100 lb. administered orally in solution, served only to delay the appearance of the typical symptomatology. The stimulatory effects of procaine easily overcame the depressive action of chloral hydrate.

b. *Cow.* One cow was injected eight times at varying dosages. Table 2 shows the results. In general, this cow was less sensitive to the stimulant action of procaine than were the horses. A dose of 10 mg. per lb. produced no recognizable difference in behavior of the cow. At 20 mg. per lb. frequent twitching of the muzzle and cleaning of the nostrils were noted. Larger injections produced additional changes, *i.e.*, frequent head-shaking, incoordination, and exaggerated reflex movements which suggested the occurrence of hallucina-

*The cooperation of the staff of the Stange Memorial Clinic is appreciated.

tions. After injecting 50 mg. per lb., the cow crumpled to the floor immediately, with marked tremors of major skeletal muscles. Brief convulsive contractions of extensor muscles occurred. An injection of 75 mg. per lb. produced a similar but more intense response.

The repeated injection of 20 and 30 mg. per lb. produced the same clinical responses as earlier. These findings indicated that neither tolerance nor hypersensitivity to procaine hydrochloride occurred in this cow.

TABLE 2. Occurrence of Excitement in a Cow Following the Subcutaneous Injection of Procaine Hydrochloride Solutions

Trial No.	Dosage mg./lb.	Signs of Excitement		
		Appearance (min.)	Duration (min.)	Unusual movements
1	10	none	none	none
2	20	20	20	+
3	30	4	80	++
4	40	3	90	+++
5	50	3	125	down
6	30	5	70	++
7	20	18	24	+
8	75	2	270	down

c. *Pig.* One pig was injected 12 times with varying dosages as indicated in table 3. This pig was more sensitive than the cow to the stimulant action of procaine but somewhat less sensitive than the horses.

An injection of 10 mg. per lb. produced an uncertain response. Doubling the dosage produced a stilt-like gait, continuous sniffing and blowing through the nostrils, and repeated periods marked by chomping of jaws, retching and vomition. Larger dosages caused extreme muscle weakness, muscular tremors and incoordination. Retching and vomition was not observed with larger dosages until the recovery period, when it occurred repeatedly. Dosages of 50 mg. per lb. and higher produced a prompt and general muscular collapse, followed by convulsive seizures. The respiration became dyspneic and the iris was dilated widely.

Lower dosages of procaine hydrochloride produced the same responses as earlier indicating that no tolerance nor hypersensitivity had developed in this pig from repeated injections.

A subcutaneous injection of 200 mg. per lb. resulted in death from respiratory paralysis.

d. *Dog.* The dog was stimulated by procaine hydrochloride administered subcutaneously. The injection of 20 mg. per lb. of body weight induced salivation, retching and vomition repeatedly. Muscular tremors and twitchings of the hind legs, especially, were followed by signs of incoordination. Doubling the dosage caused the same symptoms, but they were much more severe. Neither dosage was fatal.

Injection of Procaine Hydrochloride Suspended in Oil

A 20% suspension of procaine hydrochloride was prepared by mixing the finely triturated salt with sesame oil containing 2% aluminum monostearate*. This preparation was injected both intramuscularly and subcutaneously to determine if the analgesic effects of procaine could be prolonged beyond that obtained from aqueous solutions.

The approximate duration of analgesia in the dogs was measured by the following mechanical stimuli: penetration with a 24 gauge hypodermic needle of the skin of the back and of the external ear; pinching the toes; penetration of the tail with a needle; and the introduction of a stylus into the nostril. These reflexes were noted to disappear in the above order, *i.e.*, the skin response was the first to disappear and the reflex to a stylus in the nostril was the last. For the purposes of this simple investigation, the absence of the pedal reflex was used as an arbitrary indication of analgesia.

TABLE 3. Occurrence of Excitement in a Pig Following the Subcutaneous Injection of Procaine Hydrochloride Solutions

Trial No.	Dosage mg./lb.	Signs of Excitement		
		Appearance (min.)	Duration (min.)	Unusual movements
1	10	8	briefly	±
2	20	6	60	++
3	30	5	70	+++
4	40	2	80	down
5	50	2	120	down
6	20	5	50	++
7	10	7	briefly	±
8	100	1	300	down
9	150	1	330	down
10	175	1	360	down
11	175	1	390	down
12	200	1	died	—

Table 4 shows the results obtained from injecting variable amounts of the procaine suspension into 12 different dogs. Most of these trials produced from minor to marked excitement in the dogs, which culminated in convulsions in three cases. The suspension of

*This menstruum was provided by the Pitman-Moore Co., Indianapolis, Ind.

procaine hydrochloride employed appeared to release the procaine more rapidly than desired so that excessive stimulation of the central nervous system occurred.

A good analgesia was observed in the experimental dogs following the injection of the oily suspension of procaine hydrochloride. The general analgesia obtained therefrom exceeded that produced by procaine administered in any other way in these investigations. However, the above preparation of procaine in oil would not be satisfactory for clinical use as such because the absorption of procaine is rapid, resulting in undesirable stimulation of the central nervous system. These results suggest that a more slowly absorbed preparation might be of value in prolonging the period of analgesia.

TABLE 4. Analgesia Produced in Dogs by Injections of Procaine Hydrochloride Suspended in Oil with Aluminum Monstearate

Trial No.	Site of Injection	Dosage (mg./kg.)	Analgesia (min.)
1	Intramuscular	62.5	briefly
2	"	62.5	briefly
3	"	73.5	briefly
4	"	146	60
5	"	147	65
6	"	150	60
7	"	200	**
8	"	208	120
9	Subcutaneous	50	briefly
10	"	100	30
11	"	150	70
12	"	150	75
13	"	150	80
14	Subcutaneous*	150	(confused)
15	"	200	175
16	"	200	180
17	"	200	195
18	"	200	**

*Injection unwittingly made into inflamed site of previous injection; a sterile abscess containing oil and fluid opened four days later.

**Good momentary analgesia but duration confused by convulsions.

Intravenous Injections in the Cow

An intravenous injection of 6 mg. per lb. of body weight administered in a 4% solution by slow regular infusion during six minutes produced the following transitory reactions: twitching and wrinkling of the muzzle; continuous cleaning of the nostrils; shaking of the head and a general alertness.

An injection of 20 mg. per lb. in a 4% solution administered evenly during 14 minutes caused a profound reaction as noted below in minutes from the beginning of infusion:

2 minutes—muzzle twitching
3 minutes—nervousness, head-jerking
6 minutes—muscular tremors
8 minutes—went down on sternum
10 minutes—slight nystagmus, lacrimation
12 minutes—marked and constant tremors of leg muscles
14 minutes—injection completed
16 minutes—head released; cow fell onto her side; eyeballs rotated inward and upward; extensor muscles tensed; no movement
20 minutes—strongly responsive to electrical stimulation
23 minutes—arose to sternum
27 minutes—relatively alert but reflex movements of head exaggerated
42 minutes—prodded to feet with much effort; legs far apart and shaking under the strain
120 minutes—recovered

The respiration and pulse varied somewhat but did not change in a correlative or significant fashion during the above injections. The response to the stimulation of an electrical prod suggested that analgesia did not result from the intravenous infusion of procaine solution, or, if present, was very transient.

Conclusions

The stimulant action of procaine hydrochloride upon the central nervous system of domestic animals can be a factor which increases the difficulty in handling and restraining animals during treatment. Horses are probably more susceptible to this excitant action than are the pig, the cow, and the dog.

The quantity of procaine hydrochloride necessary to stimulate the central nervous system appears to be considerably larger than that used commonly to produce local anesthesia, so that a considerable margin exists between the two dosage levels.

The intramuscular and subcutaneous injection of procaine hydrochloride suspended in oil produced the best analgesia observed. However, the rate of absorption from this relatively crude preparation was too rapid and produced a degree of excitement considered too great for clinical use. It seems probable that a menstruum could be prepared which would release the procaine more slowly to produce analgesia without excitement.

▼ ▼ ▼

Broodiness in both chickens and turkeys is an inherited characteristic which can be largely eliminated by a careful breeding program.

Gut Edema or Paralytic Toxicosis of Swine

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The syndrome listed under the rather inappropriate name of gut edema qualifies as a specific disease entity of swine. Its occurrence has been reported in Great Britain, Norway, Sweden, Holland, Canada and the United States. According to Lamonst, of Belfast, gut edema is the most economically important disease in the heavily concentrated swine-raising countries of North Ireland (Ulster).

In this country, Tabola, of Jackson, Minn., reported diagnosis of gut edema on some 60 farms in his practice during a single year. Recently, the Illinois Veterinary School reported an outbreak on a single farm with 32 pigs dead out of 34 affected (*Vet. Med.*, 46:179 [May], 1951). Hendrickson and Beebe of Warrensburg observed the disease in Missouri in May of this year. Five recently vaccinated shotes developed the disease and two died or were killed for autopsy. The writer has seen this gut edema syndrome for the past 30 years but had never thought of it as a specific disease entity until attention was directed to it some three years ago.

Occurrence

Gut edema occurs most commonly among pigs from six to 20 weeks of age; although swine of any age may be affected. The condition appears to be precipitated by changes of normal routine such as vaccination, feed changes, castration, or moving to new premises. As most pigs are vaccinated with serum and virus during the age bracket of greatest occurrence, gut edema is frequently noted as a complicating factor in the so-called "early breaks."

The disease may occur under all conditions of husbandry and feeding but some evidence points to greater morbidity in groups of pigs on rich pastures and when intake of protein supplements is high. Usually, the disease occurs sporadically; given litters or the biggest and best pigs in the drove are most frequently affected.

Symptoms

In a typical outbreak of gut edema, history is regularly given that sudden, unexplained deaths had occurred. On examination of the drove, a variable number show marked edema of one or both eyelids which may extend well down the nose. Edema of the throat latch, one or both ears, or the vulva may be noted. When moved, there is a characteristic swaying gait. Later, there is progressive paralysis of either the front or hind limbs. The body temperature is normal or subnormal. Affected animals are conscious and try to move when disturbed. The normal squeal is distorted to a hoarse bark in some pigs because of edema of the glottis. Some have convulsive fits. In typical cases, complete paralysis and a period of decubitus are followed by death in from six to 24 hours after symptoms are first noted. The picture is rather like that observed in pigs poisoned by young cockleburs.

Autopsy Findings

Upon postmortem examination, rigor mortis is noted and a reddish blush of the underline. Muscles are somewhat paler than normal. Kidneys, spleen and liver show little, if any, change. Peritoneal and pleural cavities, as well as the pericardial sac, carry excess fluid transudates which gel on exposure to air. The lymph glands, more especially the portal and mesenteric, are enlarged, juicy and purple red.

When the belly plate is thrown back, the coils of the colon are noted to be imbedded in a jelly-like mold. On palpation a distinct thickening of the stomach wall along the greater curvature toward the cardiac rather than the pyloric portion may be detected. When sectioned, the musculature and mucosa of the stomach wall are separated by a jello-like mass. Thickening of the gastric wall may range from near normal to more than an inch thick. The gastric mucosa beneath the area of edema is distinctly red and one or more small ulcers may be seen. The mucosa of the small intestines is thrown into tight folds and the ridge line of these folds is reddened. The rectum may be a deep purple-red, especially within a few inches of the anus. The heart may be petechiated and, sometimes, a mulberry-colored blotching of the myocardium is seen.

Control and Treatment

While the specific cause of gut edema has not been conclusively postulated, research report of Timoney, of Ireland, quite clearly indicates that the disease is a toxemia. He reproduced the disease in 34 pigs by intravenous injection of filtrates from the content of the small intestines. All other types of transmission attempts proved negative. Timoney concludes that the disease is caused by a toxin, either

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The Use Of Calcium Gluconate In The Treatment Of Lindane Poisoning Of Dogs*

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AMONG the several reports of the acaricidal action of benzene hexachloride (BHC) are a few accounts of its use in the treatment of demodectic mange of dogs. In 1947, Dodson[6] obtained favorable results in a number of trials with a 1% suspension of crude benzene hexachloride in liquid petrolatum. Unfortunately, it was implied in the summary of the article that the trials were made with a 1% suspension of the gamma isomer; but since this isomer usually comprises only 10 to 12% of the crude product, the preparation probably contained about 0.1% gamma benzene hexachloride. The implied formulation was recorded in at least two published abstracts of the article[7, 8] in 1948; and in October 1949, Foster[9] made reference to the use of 1% gamma BHC in mineral oil in a brief summary of recent reports describing newer treatments for demodectic mange of dogs. It may be noted, however, *vide infra,* that preparations containing 1% gamma BHC have been used in the treatment of human scabies.

Watson,[21] in July 1948, reported complete success in nine of 21 cases of demodectic mange that were treated with gammexane; and partial success was obtained in eight of the others. No information was given, however, with respect to dosage, regimen of application, and tolerance by the hosts. One month later, Muma and Spencer[18] noted marked improvement but not complete eradication of demodectic mange in dogs that were dipped in a 0.25% suspension of the gamma isomer; exceptionally large or severe lesions were scrubbed with a firm-bristled brush while the animal was in the liquid. These various reports indicate that gamma benzene hexachloride may prove to be an effective agent in the treatment of demodectic mange of dogs; but it is evident that neither the optimum dosage nor the most suitable regimen of application has been established. It seems probable, moreover, that the risk of intoxication has been insufficiently emphasized.

Procedure

On January 9, 1950, an aqueous emulsion containing 0.15% lindane (gamma BHC) was applied by wash to the entire body surface of two mature Walker Fox Hounds afflicted with mild, generalized demodectic mange. The principal lesions were on the ears and legs. Approximately 2,500 cc. of the emulsion were used for the two animals; but since neither dog was clipped, there was a rather substantial run-off. The treatment was well tolerated, but after 16 days there was no apparent change in the appearance of the lesions. It seemed desirable, therefore, to alter the regimen. Consequently, two formulations were prepared, one containing 0.5% lindane in water and the other containing a similar concentration of the chemical in mineral oil.

The aqueous emulsion was applied thoroughly by wash to the entire body surface of the female. The animal weighed about 40 pounds and approximately two liters of the emulsion were used. As in the previous trial, however, there was a fairly large run-off. It was proposed to apply the mineral oil preparation to half the body surface of the male on each of two successive days, and an initial application of about 500 cc. of the material was applied to that portion of the body surface posterior to the umbilicus. The dog weighed about 50 pounds, and in this instance the run-off was negligible.

Observations

Both animals ate their normal ration of commercial pellets when they were returned to their separate cages, and the dogs were next observed about one hour after treatment. At this time, the female was exhibiting marked symptoms of acute intoxication, and it was evident that the toxic reaction was well advanced. The symptoms included ptyalism, champing of the jaws, vomition, mydriasis, apparent blindness, hyperpnea, tachycardia, tremors, twitching, hyperesthesia, incoordination, clonic spasms, and marked anxiety. The spasms became progressively more severe and within a few minutes the animal was unconscious.

*From the Zoological Division, BAI, Agricultural Research Administration, U. S. Department of Agriculture, Washington 25, D.C.

At this time, approximately one and one-half hours after treatment, the dog was given 20 cc. of a calcium gluconate preparation* intraperitoneally, and was bedded down and covered to conserve body heat. There was no immediate change in the condition of the animal, but two hours later the dog showed considerable improvement. The animal was again on its feet, the eyes were essentially normal, respiration was considerably less labored, and the tremors and twitching had virtually ceased. Extreme weakness was still evident, however, especially in the hind quarters, and the animal walked with considerable difficulty. At this time the dog was given another 35 cc. of the calcium gluconate preparation intraperitoneally. Marked salivation continued and the dog vomited several times, but three hours later the animal appeared to be resting comfortably.

The next morning the only persisting indications of intoxication were weakness, depression, and inappetence. The dog drank some milk but showed no interest in solid food. There was no appreciable improvement during the day, and consequently a third dose of 20 cc. of the calcium preparation was given in the afternoon.

The following morning, about 48 hours after toxic symptoms were first exhibited, the dog showed only slight evidence of incoordination. The animal ate a small amount of canned dog food and drank some milk, but did not touch the regular pellets. Because lassitude persisted, another dose of 20 cc. of the calcium gluconate preparation was given in the afternoon.

The dog showed gradual improvement during the next two days. On the fifth day, however, she was again off-feed, depressed, and inactive; and another dose of 20 cc. of the calcium gluconate preparation was given intraperitoneally. Thereafter the animal showed progressive improvement and was apparently fully recovered on the seventh day.

The male showed no indication of unfavorable reaction on the day of treatment. The following morning, however, the dog was slightly depressed and consumed only a small amount of feed. Definite symptoms of intoxication were first observed about 27 hours after treatment, and they consisted of apprehension, restlessness, and labored breathing. This was soon followed by slight generalized twitching, champing of the jaws, profuse salivation, mydriasis, and marked anxiety. The frequency and severity of the twitching increased rapidly, resulting ultimately in clonic spasms and marked incoordination. Finally, the dog fell on its side with the legs constantly in motion, and it appeared to be completely unaware of its surroundings. The animal soon developed a tonic spasm and immediately it was given 50 cc. of the calcium gluconate preparation intraperitoneally. Within a few minutes the dog was on its feet and most of the symptoms had subsided considerably. Profuse salivation and champing of the jaws continued, however, and the patient vomited several times.

Approximately one hour after the calcium gluconate was given, the dog appeared to be resting fairly comfortably although slight twitching persisted and the animal was extremely weak. An additional 30 cc. of the calcium gluconate preparation was given three hours later.

The following morning the animal was weak but walked without too much difficulty. The appetite was poor, but the animal drank some milk and ate a small amount of canned dog food. In the afternoon, a final dose of 30 cc. of the calcium gluconate preparation was given intraperitoneally. Thereafter the appetite and general condition gradually improved, and with the exception of some loss in body weight there was no evidence of intoxication after three days.

About five weeks after the 0.5% lindane preparations were applied to these animals, two skin scrapings were taken from each dog but no mites were found. Moreover, there were no apparent active lesions on either animal although some bare, reddish areas persisted on the legs. It is noteworthy that at this time there were no lesions on the ears of the male notwithstanding that the anterior half of the dog was treated with only the 0.15% aqueous emulsion. It is not known, therefore, whether the result was effected by the 0.15% application or by the absorbed chemical from the heavier

*The product contained calcium aluminogluconate, equal to calcium gluconate, 15%; dextrose, 20%; phosphoric acid, magnesium chloride, and calcium hypophosphite.

application to the posterior half of the animal. Both dogs were in very good physical condition, the male and female weighing 60 and 45 pounds, respectively, and the observations were terminated.

Discussion

The symptoms of lindane poisoning exhibited by these dogs were similar to those produced experimentally in various animals by Cameron and Burgess[9] in 1944 and by McNamara and Krop[14] in 1948. They resembled also those induced in dogs and other animals by DDT,[10, 20] chlordane,[9] toxaphene,[2, 12] and carbon tetrachloride,[16, 18] the intoxication in each instance being characterized principally by neurological symptoms. On this account, the favorable action of calcium in the treatment or prevention of intoxication resulting from DDT[11, 20] and carbon tetrachloride[6, 18] suggested its possible therapeutic value in poisoning from lindane. The relatively rapid response and ultimate recovery of both animals affirm this premise and suggest that perhaps calcium therapy is indicated also in the treatment of intoxications resulting from other chlorinated insecticides. The proprietary preparation contained ingredients in addition to calcium gluconate, but the overall evidence indicates that they were not of any therapeutic significance.

Several attempts have been made to define the role of calcium in the treatment or prevention of these intoxications. In 1927, Minot[16] noted that in carbon tetrachloride poisoning there was a marked increase in the concentration of bilirubin in the blood. Since the bile pigments are ordinarily detoxified by combining with ionized calcium, the reserve of this element is rapidly depleted in carbon tetrachloride poisoning and a severe bilirubinemia develops with a resultant intoxication. One year later, Minot and Cutler[17] reported a marked rise of guanidine in the blood coincident with the onset of symptoms of carbon tetrachloride poisoning. Moreover, there was a fall in blood sugar within a few hours after an appreciable increase in blood guanidine, and the hypoglycemia appeared to be the immediate cause of death. With the administration of calcium salts, the blood sugar level was restored and maintained at safe level; but when the blood sugar level was maintained by the administration of dextrose, the nervous symptoms were not relieved. In their opinion, the symptoms of carbon tetrachloride poisoning were apparently due largely to the accumulation of guanidine because similar symptoms could be produced in normal animals by administering guanidine hydrochloride.

In gammexane (=BHC) poisoning of dogs,

however, McNamara and Krop[15] found that serum bilirubin and nonprotein nitrogen levels remained normal. Vaz, *et al.*,[20] postulated that DDT produced a lowering of blood calcium and suggested that the apparent neurological symptoms observed in DDT poisoning were consequent to hypocalcemia rather than direct neural injury. The postulation was based upon the favorable action of calcium gluconate in the prevention and treatment of experimental intoxication of dogs by DDT rather than upon chemical analyses of the serum calcium level in these animals. Judah[11] found, however, that blood serum calcium concentrations were not lowered in rabbits two and one-half hours after intravenous injections of lethal doses of DDT. He found that intravenous injections of calcium gluconate protected rats against lethal doses of the chemical, but this protective action was not attributed to the alleviation of a hypocalcemia. Thus, the value of calcium in the treatment of intoxication from these chlorinated hydrocarbons seems indisputable although its mode of action has not been determined in poisoning resulting from the chlorinated insecticides.

In further consideration of the treatment of acute gammexane poisoning in dogs, McNamara and Krop[18] reported that pentobarbital and phenobarbital, administered symptomatically in dosages ranging from 5 to 25 mg. per kg., effectively antagonized the toxic effects of large intravenous doses of gammexane. In the judgment of these investigators, the ideal therapeutic regimen would consist in the administration of a small dose of phenobarbital with subsequent, symptomatic doses of a short-acting barbiturate to control violent convulsive seizures; the value of artificial respiration and

cardiac massage was also emphasized. In our opinion, however, the use of barbiturates is essentially a palliative procedure whereas calcium appears to have a more direct antidotal action. Moreover, the usefulness of calcium has been demonstrated in intoxications resulting from other chlorinated hydrocarbons in which the symptomatology is similar to that of gammexane poisoning. Probably the best regimen would consist in the judicious administration of both chemotherapeutic agents: an initial dose of a suitable barbiturate for its immediate effect, and concomitant and subsequent injections of calcium for its antidotal action. It is important also to encourage the animal to consume liquids and solid food at all times. A similar regimen was suggested by Jones,[10] in April 1950, for the treatment of intoxications in cats resulting from chlordane and toxaphene.

In connection with the toxicity of benzene hexachloride, McNamara and Krop[14] found that pure gamma BHC was more toxic than a mixture of the isomers with an equivalent gamma isomer content. This was attributed to the antithetical action of the various isomers on the central nervous system. Gammexane produced a marked central stimulation whereas the action of the beta and delta isomers was one of depression. The antagonism between the various isomers was not considered of any value, however, in the treatment of gammexane poisoning[15]. A similar relationship between pure gamma benzene hexachloride and the other isomers was noted by Barke[1] in 1949. In comparable dosages, preparations made from the pure gamma isomer appeared to be more toxic than those made from the crude product. The findings of these investigators suggest that perhaps the crude product is preferable in compounding preparations for direct use on infested animals.

Furthermore, in the use of preparations containing benzene hexachloride it appears that the concentration of gamma BHC has been considered of paramount importance and that the significance of the total dose of the isomer has been insufficiently emphasized. This is illustrated by the severe toxic reactions that were produced in these dogs with preparations containing 0.5% lindane whereas Wooldridge[22] and Cannon and McRae[4] used 1% gamma BHC in a vanishing cream base for the treatment of human scabies and noted no unfavorable reactions attributable to the acaricide. The cream was applied to the entire cutaneous surface in infants and from the chin to the sole of the feet in adults. In the trials by Cannon and McRae, the average adult required 15 to 25 gm. of the cream per treatment; and in some of the patients a second application was given after one week. Moreover, Wooldridge gave each of his patients, varying from eight weeks to 82 years of age, as much as 2 oz. of the preparation. In about half of the cases, the entire amount was applied in a single treatment; and in the others, two equal applications were made at 12-hour intervals. These experiences suggest, therefore, that coordinate consideration should be given to both the total dose and the concentration of the gamma isomer.

Summary

Two dogs afflicted with demodectic mange developed symptoms of acute poisoning following treatment with preparations containing 0.5% lindane in water and mineral oil, respectively. With the aqueous emulsion, applied by wash to the entire body surface, toxic symptoms were manifested within one hour; but with the mineral oil preparation, applied to only half of the body surface, toxicity was not observed until approximately 27 hours after treatment. Both animals recovered completely following several intraperitoneal injections of a calcium gluconate preparation.

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The Effect Of Hyaluronidase On The Absorption Of Sera*

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THE enzyme hyaluronidase has received considerable attention since the report of Duran-Reynals[1].

As a result of recent reports, it has been accepted in veterinary practice as a valuable adjunct to several routine therapeutic and prophylactic procedures. Eveleth, Holm, and Bolin[2] reported on the use of this enzyme in calcium gluconate medication. Holm[3] described the results of hyaluronidase studies when administered with saline, calcium gluconate, procaine, mineral oil and peanut oil. Bolin, Eveleth, and Bolin[4] described the use of hyaluronidase with water-miscible vitamin A, and West[5] described case studies of the use of the enzyme in small animal practice. McClean and Morgan[6] and McClean, Morgan, and Favilli[7] reported on the value of crude preparations of testicular hyaluronidase when mixed with diphtheria antitoxin for subcutaneous injections in guinea pigs.

Great variation in the molecular weight of antibodies is well known. The variations apparently depend on animal species, antigen, antigen purity and still other factors. Current knowledge on the physical and chemical structure of antibodies is thoroughly discussed by Kabat and Mayer[8].

It is generally agreed that antibody activity is a function of the globulin molecules[8,9]. Since antibodies are found in the globulin fractions of serum, it can be assumed that if a hyaluronidase effect is exhibited on one antibody, similar effects can be expected on others. Agglutinin concentrations are easily titrated; therefore, could act as an indicator of speed and degree of diffusion when injected into test animals. This study was designed to take advantage of the above facts and theories to determine the value of hyaluronidase in the absorption of homologous and heterologous serum.

In this work, the authors outline positive proof of the beneficial effects to be derived from the addition of hyaluronidase to parenteral solutions.

The technic for demonstrating results of absorption by measuring antibody titer increase in animals due to injected serum containing known quantities of antibodies, is classical and unique. It furthermore adds conclusive evidence to facts already established, illustrating clinical advantages of routine use of hyaluronidase to speed absorption of serum, some vaccines, or other preparations designed for parenteral use, when these are administered either intramuscularly or subcutaneously.

Materials and Methods

The sera used in this investigation were produced by immunizing calves, sheep, swine and horses against *Brucella abortus* strain 19. All vaccinates were bled periodically; when the desired blood titer was reached, final bleedings were made. The blood was allowed to clot and the serum extracted by centrifugation. The sera were pooled by donor class and phenol was added to a concentration of 0.5% for each lot of serum. Final preserved serum dilution titers were maintained at 1:400 for bovine, ovine and equine sera and at 1:200 for porcine serum. The porcine serum was standardized at a titer of 1:200 because it was difficult to maintain a peak of 1:400 in a group of *Br. abortus* strain 19 vaccinates long enough to get pooled serum.

The test or recipient animals were healthy calves, sheep or swine. They were grouped for their specific injections to permit paired comparisons. All test animals were blood tested and negative to the brucellosis serum agglutination test at a dilution of 1:12.5 prior to serum injections. Serum-injected animals were bled for testing at two-hour intervals during the first 24 hours and at intervals of 24 hours until all in the group returned to negative in the 1:12.5 dilution. These animals were used for only one trial.

In order to assign values to agglutination readings which would give numerical values suitable for statistical interpretation, regardless

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of dilution or completeness of agglutination, a standard curve was drawn. Values of zero to 100 were assigned for degrees of agglutination in various dilutions; the coordinate showing 16 possible agglutination readings. Values for readings of complete agglutination between zero to 100 were read directly from the standard curve.

The data were subjected to an analysis of variance, Snedecor[9]. To facilitate the calculations the analyses were performed using the mean values for each time of reading rather than the individual readings. The mean values were transformed $\sqrt{(x + 0.5)}$ to allow for the "zero" observations (readings with no agglutination at 1:12.5). The second order interactions were tested for statistical significance using the mean square of the third order interaction for the error term, whereas the treatment, serum, and time were tested using the more appropriate second order interaction. All means are reported with the probable deviation. In this paper significant refers to statistical significance at 5% level and highly significant refers to significance at 1% level.

EXPERIMENTAL RESULTS AND DISCUSSION

Sheep

A total of 52 sheep were divided into ten groups. These animals received equine, ovine and bovine sera, with or without hyaluronidase. Eight groups were injected by the subcutaneous method and two intramuscularly.

Equine serum. Three groups of sheep were injected subcutaneously with equine serum to which had been added 30, 60 and 120 T. R. units** of hyaluronidase per 100 ml. respectively. (See figure 1 and table 1, chart section).

There were insignificant differences between the three levels of hyaluronidase. Apparently 30 T. R. units of hyaluronidase per 100 ml. of serum gave ample spreading effect, *i.e.*, depolymerized the hyaluronic acid of the subcutis.

The sheep receiving equine serum and 30 T. R. units hyaluronidase was matched with a comparable group which received equine serum but no hyaluronidase. (Figure 2 and table 2).

The data indicate that there was a marked difference in favor of the hyaluronidase treatment. Differences were noteworthy from the 8th to 72nd hour. A secondary rise in titer levels was noted. This same observation was made when equine serum was used on calves (figure 5).

Ovine serum. Two groups of sheep were injected subcutaneously with ovine serum. One group of animals received the serum and 30 T. R. units of hyaluronidase and the others serum alone. (Figure 3 and table 3).

The data indicate evidence of improved absorption in hyaluronidase treated animals. The differences were greatest from the 4th to 20th hour. The serum alone group did not approach the level of the treated serum but did maintain a plateau for 48 hours.

The next investigation was undertaken to determine whether hyaluronidase would enhance the absorption of serum injected into the muscle.

Two groups of animals were injected intramuscularly with ovine serum; one group receiving serum and 30 T. R. units of hyaluronidase and the other serum alone. (Figure 4 and table 4).

The data indicate a slight difference in speed of absorption which favors the hyaluronidase treated serum group. However, there were no marked differences between the treatments; a result that may be partly explained on the basis of the smaller amount of hyaluronic acid present in the muscle as compared to that present in the subcutaneous tissue. The animals receiving the serum and hyaluronidase did, however, exhibit less induration at the site of injection.

Bovine serum. Two groups of sheep were injected subcutaneously with bovine serum. The animals in the first group received serum alone and those in the second group were injected with bovine serum plus 30 T. R. units of hyaluronidase. (Figure 5 and table 5).

The data again indicate a variation of absorption in favor of the hyaluronidase. The differences were extreme from the 6th to 120th hour. Bovine serum in sheep appears to produce a secondary peak titer as was experienced with equine serum.

Statistically, regardless of the type of serum injected subcutaneously, the treatment gave significant results as did the interaction of type of serum and hour. The treatment times hour was also indicative. This demonstrates that the benefit from hyaluronidase is affected by type of serum used on a given animal and the response to treatment depends upon both hyaluronidase and sera. This is further shown by study of the figures. When no hyaluronidase was used there was no statistical variation between bovine and equine sera. Ovine serum

**One T. R. (turbidity reducing) unit of hyaluronidase has the power to reduce the turbidity produced in a 0.2 mg. per ml. concentration of hyaluronic acid so that it corresponds with that of a 0.1 mg. per ml. concentration.

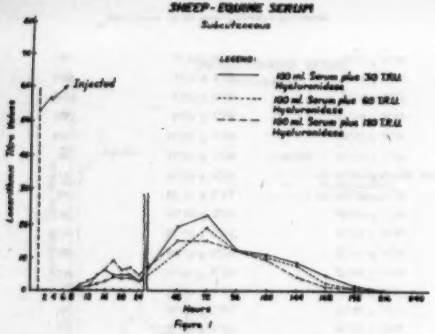

Figure 1

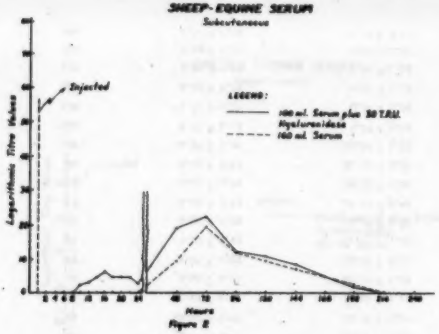

Figure 2

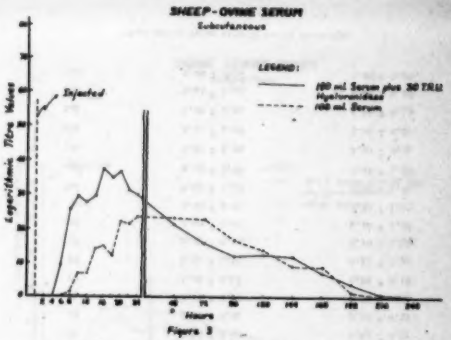

Figure 3

LOGARITHMIC TITRE VALUES
Sheep - Equine Serum
Subcutaneous
(Five Animals Per Group)

Avg. Wt.	GROUP A 120.8 lb. 100 ml. 30 T.R.U.	GROUP B 121.0 lb. 100 ml. 60 T.R.U.	GROUP C 119.8 lb. 100 ml. 120 T.R.U.
Hour			
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
8	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
10	2.08 ± 0.52	1.04 ± 0.63	1.10 ± 1.10
12	3.18 ± 0.58	1.56 ± 0.63	1.62 ± 1.09
14	4.58 ± 1.98	2.08 ± 0.52	4.44 ± 2.15
16	6.58 ± 2.53	3.18 ± 0.49	6.54 ± 2.58
18	4.58 ± 1.98	4.34 ± 0.53	9.52 ± 3.59
20	4.56 ± 1.98	3.76 ± 0.53	6.86 ± 3.59
22	4.44 ± 2.24	4.34 ± 0.53	7.38 ± 4.79
24	2.72 ± 1.23	2.66 ± 0.49	4.34 ± 3.10
48	18.30 ± 3.91	11.32 ± 4.48	15.00 ± 4.19
72	22.30 ± 1.90	18.52 ± 0.20	15.20 ± 2.58
96	12.16 ± 2.85	12.16 ± 2.85	12.16 ± 2.85
120	11.26 ± 2.23	10.58 ± 2.58	9.90 ± 2.70
144	6.74 ± 3.22	7.90 ± 2.57	5.18 ± 1.75
168	4.60 ± 1.62	2.60 ± 0.87	2.08 ± 0.52
192	1.62 ± 0.72	1.04 ± 0.55	1.04 ± 2.55
216	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

TABLE 1.

LOGARITHMIC TITRE VALUES
Sheep - Equine Serum
Subcutaneous
(Five Animals Per Group)

Hour	GROUP I 120.4 lb. avg. wt. 100 ml. serum no hyaluronidase	GROUP II 120.8 lb. avg. wt. 100 ml. serum 30 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	0.00 ± 0.00
8	0.00 ± 0.00	0.00 ± 0.00
10	0.00 ± 0.00	2.08 ± 0.52
12	0.00 ± 0.00	3.18 ± 0.58
14	0.00 ± 0.00	4.58 ± 1.98
16	0.00 ± 0.00	6.56 ± 2.53
18	0.00 ± 0.00	4.58 ± 1.98
20	0.00 ± 0.00	4.58 ± 1.98
22	0.00 ± 0.00	4.44 ± 2.24
24	0.00 ± 0.00	2.72 ± 1.23
48	9.80 ± 4.30	18.30 ± 3.91
72	19.52 ± 4.52	22.30 ± 1.90
96	12.10 ± 2.80	12.16 ± 2.85
120	10.00 ± 2.84	11.26 ± 2.23
144	7.38 ± 2.88	6.74 ± 3.22
168	4.60 ± 1.62	4.60 ± 1.62
192	2.08 ± 0.55	1.62 ± 0.73
216	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

TABLE 2.

LOGARITHMIC TITRE VALUES
Sheep - Ovine Serum
Subcutaneous
(Six Animals Per Group)

Hour	GROUP I 81.3 lb. avg. wt. 100 ml. serum no hyaluronidase	GROUP II 81.7 lb. avg. wt. 100 ml. serum 30 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	9.50 ± 3.01
8	1.30 ± 0.58	25.52 ± 2.94
10	7.05 ± 2.45	29.50 ± 4.62
12	7.32 ± 2.90	27.83 ± 5.11
14	14.20 ± 1.70	29.20 ± 6.05
16	15.02 ± 4.10	37.20 ± 7.89
18	12.14 ± 4.46	34.90 ± 5.85
20	21.92 ± 7.35	36.50 ± 6.88
22	21.42 ± 8.83	38.90 ± 5.02
24	23.64 ± 6.16	29.70 ± 5.38
48	23.44 ± 3.46	21.13 ± 6.30
72	22.92 ± 3.98	15.66 ± 4.12
96	16.83 ± 3.40	12.18 ± 3.53
120	13.83 ± 2.69	12.93 ± 3.76
144	9.38 ± 2.62	12.18 ± 3.53
168	9.00 ± 3.05	7.38 ± 3.17
192	1.73 ± 0.55	3.61 ± 2.62
216	0.00 ± 0.00	0.43 ± 0.43
240	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

TABLE 3.

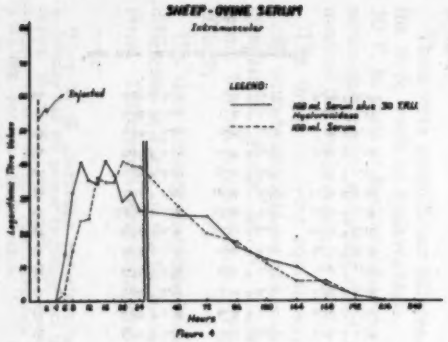

Figure 4

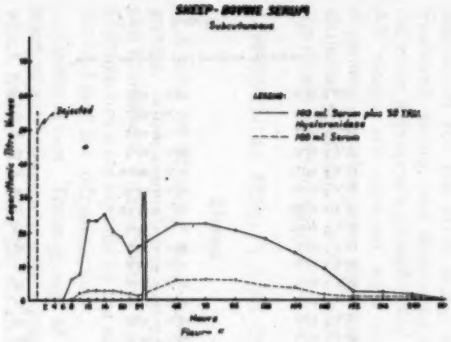

Figure 5

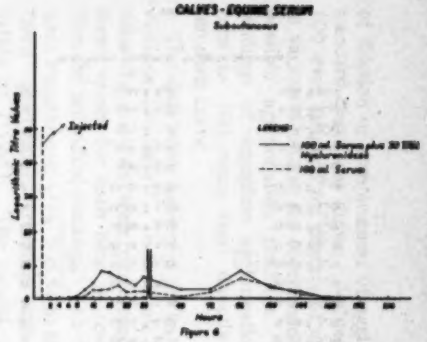

Figure 6

LOGARITHMIC TITRE VALUES
Sheep - Ovine Serum
Intramuscular
(Six Animals Per Group)

Hour	GROUP I 78.6 lb. avg. wt. 100 ml. serum no hyaluronidase	GROUP II 78.7 lb. avg. wt. 100 ml. serum 30 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	2.81 ± 0.83	13.89 ± 4.69
8	14.86 ± 3.68	31.35 ± 4.79
10	23.42 ± 4.62	40.25 ± 2.00
12	24.00 ± 5.80	35.12 ± 2.84
14	36.05 ± 5.53	34.00 ± 3.07
16	34.50 ± 4.51	41.05 ± 4.63
18	34.50 ± 4.51	36.85 ± 1.52
20	40.50 ± 4.50	29.00 ± 2.51
22	41.60 ± 6.20	31.50 ± 2.94
24	39.80 ± 5.90	28.42 ± 3.05
48	27.33 ± 4.11	25.25 ± 3.39
72	20.16 ± 2.09	24.99 ± 4.83
96	17.83 ± 2.89	16.60 ± 3.23
120	11.43 ± 3.22	12.49 ± 2.78
144	6.36 ± 1.43	10.65 ± 2.95
168	5.95 ± 2.07	5.10 ± 2.63
192	1.73 ± 0.55	1.76 ± 0.86
216	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

TABLE 4.

LOGARITHMIC TITRE VALUES
Sheep - Bovine Serum
Subcutaneous
(Four Animals Per Group)

Hour	GROUP I 117.2 lb. avg. wt. 100 ml. serum no hyaluronidase	GROUP II 117.0 lb. avg. wt. 100 ml. serum 30 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	0.00 ± 0.00
8	0.00 ± 0.00	6.08 ± 3.47
10	1.95 ± 0.65	7.93 ± 4.41
12	2.60 ± 0.00	23.37 ± 5.58
14	2.60 ± 0.00	23.37 ± 5.58
16	2.60 ± 0.00	25.18 ± 7.13
18	2.60 ± 0.00	20.50 ± 6.97
20	1.95 ± 0.65	18.81 ± 5.53
22	1.30 ± 0.75	14.15 ± 3.99
24	0.65 ± 0.65	16.00 ± 3.66
48	6.15 ± 3.63	17.75 ± 2.02
72	6.15 ± 3.63	17.62 ± 1.22
96	6.15 ± 3.63	15.72 ± 2.50
120	4.77 ± 3.99	13.60 ± 1.83
144	4.13 ± 4.13	9.22 ± 2.84
168	1.37 ± 1.37	4.90 ± 1.89
192	0.65 ± 0.65	2.67 ± 1.12
216	0.65 ± 0.65	2.25 ± 1.31
240	0.65 ± 0.65	1.38 ± 1.38
264	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

LOGARITHMIC TITRE VALUES
Calves - Equine Serum
Subcutaneous
(Six Animals Per Group)

Hour	GROUP I 306.33 lb.avg.wt. 100 ml. horse serum no hyaluronidase	GROUP II 308.66 lb. avg. wt. 100 ml. horse serum 30 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	0.00 ± 0.00
8	0.00 ± 0.00	0.43 ± 0.43
10	0.43 ± 0.43	2.65 ± 0.71
12	2.82 ± 0.84	5.10 ± 0.95
14	4.65 ± 0.71	8.50 ± 2.84
16	3.09 ± 0.48	8.08 ± 2.16
18	4.04 ± 1.65	6.15 ± 1.35
20	1.73 ± 0.55	5.70 ± 1.48
22	2.08 ± 2.04	4.39 ± 1.78
24	2.08 ± 2.04	6.73 ± 1.63
48	0.43 ± 0.43	2.95 ± 1.80
72	2.10 ± 2.08	2.95 ± 1.80
96	4.57 ± 2.56	6.50 ± 2.84
120	3.91 ± 1.78	3.57 ± 0.60
144	1.79 ± 0.91	2.16 ± 0.43
168	0.43 ± 0.43	0.00 ± 0.00
192	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

TABLE 6.

*Mean Titre Value with Probable Deviation

TABLE 5.

*Mean Titre Value with Probable Deviation

TABLE 6.

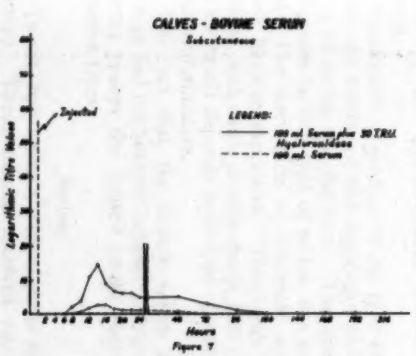

Figure 7

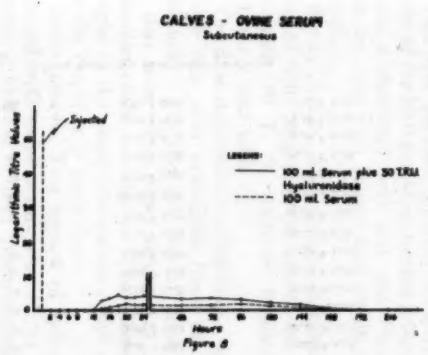

Figure 8

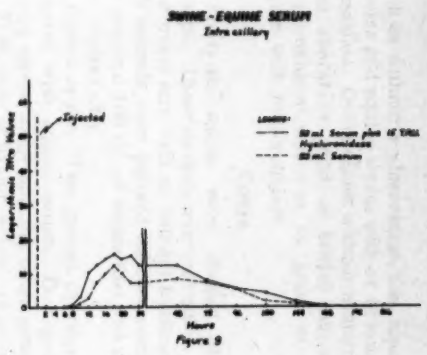

Figure 9

LOGARITHMIC TITRE VALUES
Calves - Bovine Serum
Subcutaneous
(Six Animals Per Group)

Hour	GROUP I 349.3 lb. avg. wt. 100 ml. serum no hyaluronidase	GROUP II 373.8 lb. avg. wt. 100 ml. serum 30 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	0.00 ± 0.00
8	0.00 ± 0.00	2.21 ± 0.84
10	0.43 ± 0.43	3.08 ± 0.51
12	1.73 ± 0.55	11.08 ± 2.72
14	2.60 ± 0.00	14.87 ± 4.19
16	2.60 ± 0.00	8.76 ± 2.79
18	1.30 ± 0.57	7.11 ± 2.83
20	0.86 ± 0.55	6.86 ± 1.86
22	0.86 ± 0.55	6.86 ± 1.86
24	0.86 ± 0.55	5.21 ± 1.89
48	0.43 ± 0.43	5.21 ± 1.89
72	0.00 ± 0.00	2.65 ± 0.71
96	0.00 ± 0.00	0.91 ± 0.91
120	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

TABLE 7.

LOGARITHMIC TITRE VALUES
Calves - Ovine Serum
Subcutaneous
(Six Animals Per Group)

Hour	GROUP I 349.0 lb. avg. wt. 100 ml. serum No hyaluronidase	GROUP II 349.5 lb. avg. wt. 100 ml. serum 30 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	0.00 ± 0.00
8	0.00 ± 0.00	0.00 ± 0.00
10	0.00 ± 0.00	0.00 ± 0.00
12	0.00 ± 0.00	0.00 ± 0.00
14	0.43 ± 0.43	2.65 ± 0.71
16	0.87 ± 0.55	3.51 ± 0.61
18	1.35 ± 0.93	4.60 ± 0.60
20	1.73 ± 0.55	3.57 ± 0.61
22	1.30 ± 0.58	3.57 ± 0.61
24	1.30 ± 0.58	4.60 ± 0.60
48	1.30 ± 0.58	3.57 ± 0.61
72	1.35 ± 0.93	4.05 ± 0.61
96	1.91 ± 1.43	3.57 ± 0.61
120	1.35 ± 0.93	2.21 ± 0.83
144	0.91 ± 0.91	1.73 ± 0.55
168	0.43 ± 0.43	0.43 ± 0.43
192	0.00 ± 0.00	0.00 ± 0.00

* Mean Titre Value with Probable Deviation

TABLE 8.

LOGARITHMIC TITRE VALUES
Swine - Equine Serum
Axillary Region
(Six Animals Per Group)

Hour	GROUP I 53.5 lb. avg. wt. 50 ml. serum no hyaluronidase	GROUP II 53.4 lb. avg. wt. 50 ml. serum 15 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	0.00 ± 0.00
8	0.00 ± 0.00	0.87 ± 0.55
10	1.30 ± 0.58	3.57 ± 0.61
12	3.08 ± 0.48	10.53 ± 2.60
14	7.35 ± 1.69	12.75 ± 2.00
16	10.16 ± 1.40	14.58 ± 1.44
18	12.15 ± 2.37	16.00 ± 1.70
20	10.35 ± 2.13	14.58 ± 1.44
22	7.35 ± 1.69	15.33 ± 1.82
24	7.35 ± 1.69	13.16 ± 0.69
48	8.50 ± 1.96	12.75 ± 2.00
72	8.03 ± 2.04	8.76 ± 2.79
96	5.70 ± 1.47	5.70 ± 1.47
120	1.73 ± 0.55	4.25 ± 1.65
144	0.86 ± 0.61	1.35 ± 0.93
168	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

TABLE 9.

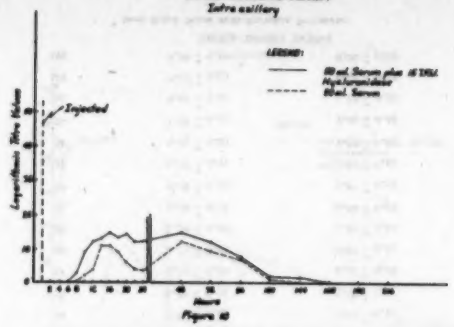

Figure 40

LOGARITHMIC TITRE VALUES
Swine - Porcine Serum
Axillary Region
(Five Animals Per Group)

Hour	GROUP I 58.1 lb. avg. wt. 50 ml. serum no hyaluronidase	GROUP II 59.0 lb. avg. wt. 50 ml. serum 15 T.R.U. hyaluronidase
Pretreatment	0.00 ± 0.00*	0.00 ± 0.00
2	0.00 ± 0.00	0.00 ± 0.00
4	0.00 ± 0.00	0.00 ± 0.00
6	0.00 ± 0.00	0.00 ± 0.00
8	0.00 ± 0.00	2.66 ± 0.87
10	2.08 ± 0.43	9.40 ± 2.95
12	3.76 ± 0.71	12.12 ± 2.55
14	11.32 ± 2.32	13.30 ± 0.80
16	11.10 ± 1.40	15.00 ± 1.70
18	9.12 ± 2.13	13.60 ± 2.57
20	6.54 ± 2.58	14.40 ± 2.61
22	4.34 ± 1.07	12.70 ± 2.01
24	3.72 ± 0.71	12.70 ± 2.01
48	12.50 ± 0.00	15.00 ± 1.79
72	9.70 ± 1.72	11.90 ± 1.79
96	7.14 ± 2.86	8.30 ± 1.72
120	1.04 ± 0.64	2.08 ± 0.52
144	0.00 ± 0.00	1.56 ± 0.64
168	0.00 ± 0.00	0.00 ± 0.00

*Mean Titre Value with Probable Deviation

TABLE 10.

with or without hyaluronidase, was superior to bovine and equine serum with or without hyaluronidase. Ovine serum without hyaluronidase was almost as good as bovine serum with hyaluronidase and was as good as equine serum with hyaluronidase.

Cattle

Thirty-six calves were divided into six groups. These animals received equine, bovine and ovine sera with or without hyaluronidase. All animals were injected subcutaneously and all received 100 ml. of serum that had a 1:400 *Br. abortus* titer.

Equine serum. Two groups of calves were injected with equine serum. One group received serum alone and the other serum plus 30 T. R. units of hyaluronidase. (Figure 6 and table 6).

The data disclose apparent dissimilarity in favor of the hyaluronidase treated group. Here again, a secondary peak titer was observed as was the case with equine and bovine sera in sheep.

Bovine serum. Two groups of calves were injected with bovine serum, one of the groups receiving 30 T. R. units of hyaluronidase. (Figure 7 and table 7).

The data demonstrate conspicuous variation which was most noticeable from the 6th to 96th hour. The titer rise and fall being typical of that seen when ovine serum was injected subcutaneously in sheep. The diversity in weight of the sheep and calves could account for the disparity in peak titers.

Ovine serum. Two groups of calves were injected with ovine serum one of the groups receiving 30 T. R. units of hyaluronidase mixed with the serum. (Figure 8 and table 8).

The data indicate a prominent difference in favor of the hyaluronidase serum treated group.

Statistically, regardless of the type of serum used, the treatment was significant as was the type of serum and the hour. The interaction of treatment and type of serum was meaningful. The interaction of treatment and hour were likewise expressive. This again demonstrated, with cattle as with sheep, that response to treatment depends upon type of serum used and hyaluronidase.

The fact that the bovine serum injected groups had the heaviest animals and the equine serum groups the lightest could account for relative titers.

Swine

Twenty-two animals were divided into four groups. These animals received equine and porcine sera with or without hyaluronidase. All animals were injected deep in the axillary region and all received 50 ml. of serum that had a 1:200 *Br. abortus* titer.

Equine serum. Two groups were injected with equine serum. The animals in one group received serum alone and the others were injected with the same amount of serum containing 15 T. R. units of hyaluronidase. (Figure 9 and table 9).

Those receiving hyaluronidase gave greater responses than the non-treated group.

Table 9 shows the trend in differences in favor of hyaluronidase treated serum animals from the 8th to 18th and from the 18th to 48th hours. The type of injection, *i.e.*, putting the serum between two groups of muscles, appears to produce serum titer levels about half way between those of intramuscular and subcutaneous injections.

Porcine serum. Two groups of animals were injected with porcine serum; in addition to the serum, one group received 15 T. R. units of added hyaluronidase. (Figure 10 and table 10).

The data again demonstrated favorable differences of the hyaluronidase serum treated group. The difference was striking from the 6th to 14th and from the 14th to 72nd hours.

Statistically there was no difference between equine and porcine sera. The treatment was advantageous when tested by the treatment times hour interaction. The interaction between the treatment and hour was significant. The porcine serum gave more rapid response than equine serum regardless of treatment. Either equine serum was used more readily by swine than by sheep or calves or the method of injection (intra-axillary) promoted more complete absorption.

Summary

1. In all phases of the study, where subcutaneous or intra-axillary injections were made, serum with hyaluronidase was absorbed more readily than the same serum without hyaluronidase.

2. In all cases, where subcutaneous injections were made, the absorption of homologous serum was superior to that of heterologous serum.

Acknowledgement

The authors wish to thank Wyeth, Incorporated, Philadelphia, Pa., for furnishing the hyaluronidase (Wydase®) used in these experiments.

Thanks are also due to M. L. Buchanan, Chief, Division of Animal Husbandry and to

W. W. Sisler, Assistant Agronomist, both of North Dakota Agricultural Experiment Station for council on statistical methods.

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New Findings Regarding Rumen Tympany

The author has shown that the enzyme, phosphatase, causes tympany†. This enzyme is found in the saliva of ruminants and in juicy legume plants. The latter are also relatively rich in arsenic, and it is known that the activity of phosphatase is increased in the presence of arsenates. The rumen juice filtrate has a high phosphate content caused by phosphorylation and dephosphorylation of the rumen content due to fermentation of its carbohydrates; a reaction which develops carbon dioxide. Tartar emetic limits this fermentation, but the required dose is so large that it becomes toxic.

For the successful control of rumen tympany, it may be necessary to find antifermentative agents capable of stopping the action of the phosphatase enzyme.—*R.S.*

†Lienert, E., Die Pharmakotherapie der Pausentympani, IV. *Wien. Tieraerztl. Monatsschr.*, 37:873 (Dec.), 1950.

Gut Edema

(*Continued from page* 438)

present in the small intestine or as a preformed toxin in feed which is activated in the gut. In this respect, gut edema is analagous to enterotoxemia of sheep. However, *Clostridium perfringens* antitoxin has been of no value in treatment.

Shanks, of England, who has had much experience with gut edema, states that the best treatment is to purge both affected and exposed pigs with a full dose of epsom salts. Purgation with salts should accompany substituting the ration with skim milk or dilute buttermilk to which may be added red dog flour, crushed oats or bran. As a detoxicant, add 1 lb. of sodium thiosulfate for each 16 to 20 head.

It is practical to treat individual sick pigs if they can be caught before they are moribund. Epsom salts and sodium thiosulfate can be given with the pig stomach tube. Antihistamine solutions diluted in isotonic saline solution, and administered intraperitoneally, may be indicated.

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Use of Calcium Gluconate in the Treatment of Lindane Poisoning of Dogs

(*Continued from page* 442)

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The National Livestock and Meat Board is authority for the statement that approximately 33½% ($9,400,000,000.) of the nation's farm income in 1950 came from the sale of cattle, hogs, and sheep.

Comparisons Of Immunogenicity Of Five Strains Of Newcastle Disease Virus As Formalinized Vaccines*

R. P. HANSON,[1] B.A., M.S., Ph.D., E. CROOK,[1] D.V.M., and C. A. BRANDLY,[2] D.V.M., M.S., Madison, Wisconsin

FORMALIN inactivated Newcastle disease (pneumoencephalitis) vaccines have been used for a number of years and have found a place in the control of Newcastle disease[1,2,4,5].

While distinct antigenic variants of Newcastle disease virus (NDV) have not yet been demonstrated, it is well recognized that some strains of the virus induce a more marked serological response following infection than do others. Certain strains of NDV have been shown to be superior antigenically to others when used as a killed virus vaccine[3].

Five strains of virus, several isolated since 1946, were selected for study of their ability to induce immunity to challenge in broilers. The group included strains of high and low lethality for chickens on basis of intravenous inoculation, and of high and low heat stability.

Strain	Isolated	Lethality for 8-week-old Chicks	Stability of Hemagglutinin in Minutes at 56 C.
B1	1948	0	5
GB	1948	10^8	
Roakin	1946	0	5
RO	1944	10^7	15
Manhattan	1948	10^9	240

The vaccines under code numbers were prepared by a commercial biological house according to the usual procedure. Fifty per cent NDV infected tissue and egg fluids were homogenized and treated with 0.4% formalin. Alumina gel was added, diluting the tissue to a final concentration of 25%, and the lot of vaccine bottled.

The vaccines were tested in stock birds of a cooperating broiler plant where continuous observations could be made. Four trials are reported. All results resembled trial 1 which will be described in detail. Four hundred unsexed New Hampshire chickens were moved to an isolation unit at three weeks of age and maintained in a brooder battery under the same conditions prevailing in the main flock. Eighty birds were placed in each of the five decks of a battery. Fifty birds were picked at random from each deck, leg banded and injected with 1 ml. of an experimental vaccine. The remaining 30 birds were left as controls. Untoward effects were not observed in the vaccinated or control animals.

At five weeks of age the birds were transferred to batteries for larger chickens according to usual plant procedure. They appeared in good health and compared favorably with birds of the same age group in the regular flock.

Four weeks and one day after vaccination, or at about seven weeks of age, a part of each vaccine group was removed to another room and challenged with a California strain of NDV, CG179. Twenty birds of each lot received intravenously an inoculum containing approximately 1,000 chicken lethal doses. Sixty birds taken from the control groups were divided into six lots of ten each. Each lot received one of six serial dilutions of the virus ranging from a 10^4 to 10^9. The chicken lethal titer of the challenge dose was calculated upon the basis of this intravenous titration in the control birds. In all of the tests a 10^4 dilution of CG179 represented approximately 10^8 lethal doses of virus for seven to 12-week-old chickens.

The birds still remaining in the isolation room were exposed to challenge at 12 weeks of age. This group was divided in the same manner as at seven weeks, and virus titrations were again made. The entire experiment was replicated. The results of the four challenges of first and second trials are shown in the chart.

All of the vaccines afforded considerable protection to a reasonably large challenge at both four and nine weeks after vaccination. However, two of the five vaccines appeared consistently superior to the others. The ques-

*Supported in part by the William C. Grunow Grant. Published with the approval of the Director of the Wisconsin Experiment Station.

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tion still remains whether challenge with another strain of virus than CG179 would reveal the same susceptibility and resistance in birds vaccinated with the five strains of virus, or for that matter, whether challenge by exposure to an aerosol rather than by the intravenous route would reveal the same pattern of resistance.

Mortality Record on Titration of NDV in Non-vaccinated Eight to 12-week-old Chickens

(A) Titration

	Deaths					
	Test 1	Test 2	Test 3	Test 4	Dead	Living
10^9	0	2	0	1	3	37
10^8	2	3	1	0	6	34
10^7	6	7	7	2	22	12
10^6	6	10	10	5	31	7
10^5	6	10	8	10	34	6
10^4	9	10	9		28	2
LD_{50}	6.5	7.6	7.1	6.2		

(B) Resistance of Vaccinated Birds to Challenge with NDV.

	Survivals						% Surviving
	Test 1	Test 2	Test 3	Test 4	Dead	Living	Challenge
B1	17	17	12	15	19	61	76
GB	19	15	18	19	9	71	88
Roakin	19	18	19	20	4	76	95
RO	19	16	15	15	15	65	81
Manhattan	20	20	18	19	3	77	96
	6	14	16	12			
Challenge LD_{50}	2.5	3.6	3.1	2.2			

Test 1 Inoculum 0.1 ml. volume.
Test 2,3,4 Inoculum 0.5 ml. volume.

In these experiments evidence was not obtained that the virulent strains of virus would produce a better killed vaccine than those of low or negligible pathogenicity. Heat stability of the virus strain did not manifest a direct relationship to the antigenicity of the vaccine. Under the conditions of these studies certain strains of NDV when prepared as formalinized vaccines were much better immunogens than others.

Acknowledgment is made of the assistance of the Fort Dodge Laboratories, Inc., for preparing the several lots of vaccine employed in this study.

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Q Fever in California

Drs. Lauri Luoto, Robert Huebner and Herbert Stoenner report (*Pub. Hlth. Repts.*, Feb. 16, 1951), on the effect of aureomycin treatment of dairy cattle naturally infected with *Coxiella burnetii*. In their summary they state as follows:

"1. Thirty-nine of 40 (97.5%) dairy cows selected for the two treatment studies on the basis of high serum antibody levels were found to be shedding *C. burnetii* in their milk.

"2. With the dosages of aureomycin used, no apparent decrease in antibodies occurred during or for a 9-11 month observation period following either intramammary or intravenous treatment.

"3. Aureomycin administered by intramammary infusion (100 mg. twice a day) for five days did not result in clearing *C. burnetii* from the milk of any ten treated cows during an 11-day observation period.

"4. The treatment of cows by daily intravenous injection of a total of 15 gm. of aureomycin over a five-day period failed to eliminate *C. burnetii* from the milk of nine of ten infected animals within three days, or from five of seven cows tested six months later.

"5. In light of present knowledge, certain practical limitations serve to minimize the possibility of a therapeutic control of Q fever in dairy cattle."

This is an interesting report, pointing out that our valuable antibiotics cannot always solve our problems. Continued investigations are being made at present with various immunizing procedures to determine if the resistance of the animal can be increased to *Coxiella burnetti* so they will not become infected and become shedders, which contaminate their lacteal secretions and also the environment. It is absolutely necessary to control these two factors of dissemination of the organism from the animals to prevent infection from occurring in man.

EDITORIAL COMMENTS

Labor Organization Seeks Professional Assignments for Non-professional Meat Inspectors

Request for reallocation of meat inspectors in order to afford non-professional employees of the BAI an opportunity to secure positions now allocated to graduate veterinarians is the subject of editorial comment appearing in *The Federal Veterinarian* for September 1951.

Contained in the Union's request is the complaint that the National Association of Federal Veterinarians is using its influence to replace with professional personnel those inspectors who (it is claimed) have been doing antemortem and routine postmortem viscera inspection for many years. It is further claimed that the employment of veterinarians for inspection duties would entail extra and unnecessary expense and be prejudicial to experienced lay inspectors.

The duties of meat inspectors, as described in the Meat Inspection Act, are clearly set forth in the first sentence by stating that they be performed under the general supervision of a veterinarian.

Obviously the Union's demands, as contained in the request mentioned above, are intended to be misleading. It should be apparent to even the uninitiated that certain specialized training is necessary to recognize disease processes that make animal food unsafe or unfit for consumption. It is so well known and accepted that the present standards of the meat inspection service provide safeguards to consumer health existent nowhere else on the globe.

The problems of making a thorough inspection, an accurate diagnosis, and a proper disposition of diseased animals and their carcasses and parts would seem to test the skill of even the best educated and most experienced veterinarians, especially when this work must be done in crowded livestock pens and on fast moving tables and rails where hundreds of animals are slaughtered per hour.

The very thought of entrusting such duties and responsibilities to laymen seems reprehensible and repugnant to persons trained in pathology and the diseases of animals. If favorable consideration were given to the Union's request, the high esteem established by the Federal Meat Inspection Service throughout the world would soon come into disrepute, consumers' confidence would be lost, and appropriations for the conduct of the service would not be justified.

Any attempt to break down present professional standards in the federal inspection service should be vigorously resisted from a public health, as well as economic, standpoint.

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Growth Stimulating Action of Antibiotics

Many feeding experiments have indicated the value of antibiotics for growth stimulation in young pigs. Powick, *et al.*, (*Jour. An. Sci.*, 10:617 [Aug.], 1951) report investigations of the relationship of diet to necrotic enteritis in young pigs. A phase of these experiments dealt with the effects of artificial infection with *Salmonella cholerasuis* of pigs fed a basal ration supplemented with either aureomycin, vitamin B_{12} or nicotinic acid, or combinations of these. Pigs were maintained on these rations for six weeks prior to the addition of cultures of *Sal. cholerasuis*.

Statistical analysis of growth and gain in various lots during the preliminary feeding period, confirms the impression that the addition of vitamin B_{12} to the basal diet was without significant effect. For the first three weeks pigs fed aureomycin or nicotinic acid made comparable gains and both demonstrated the growth acceleration stimulus of these two agents. From the third week on, however, growth in pigs receiving no nicotinic acid appeared to be retarded and the addition of aureomycin in the presence of adequate nicotinic acid produced no effect on growth or gains.

The authors postulate that accessory factors contained in live microorganisms of the intestinal tract are not available to the host, whereas those in dead microorganisms became so. Aureomycin, by its killing of certain types of bacteria, renders these accessory factors available and during this period nicotinic acid may be released by the killed bacteria. Prolonged feeding of the antibiotic would leave only resistant microorganisms so that the source of nicotinic acid would be lost. This theory may explain the limitations in observed growth stimulation in pigs fed antibiotics.

Feeding of the culture of *Sal. cholerasuis* at the end of the six weeks' feeding period produced little effect on any of the pigs which could be related to the dietary treatments.

Hyperkeratosis (X-disease) Produced Experimentally

Recently, symptoms and characteristic changes observed in field cases of hyperkeratosis (X-disease) have been produced in cattle under controlled experimental conditions.

A number of toxic or "harmful" agents appear to be responsible. According to a news release from the Agricultural Research Administration, these agents are not present in all lots of identical feeds, but may enter the product as a contaminant or develop later in such a manner as to produce the disease.

This report appears to spike the infectious theory of hyperkeratosis but mentions a possible infection producing symptoms similar to X-disease in its early stages.

Research work on this problem is under way at ten state experiment stations.

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Tuberculosis (all forms) caused a death rate of 46.7 per 100,000 population in New York City in 1946; a reduction from 57.1 reported for 1939. London reports incidence as 70.2 and reduction from a wartime high of 124.8 recorded for 1941.—*Vital Statistics, W. H. O.*

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Successful control of enterophepatitis (blackhead) of turkeys by the use of 2-amino-5-nitrothiazole (ANT) has been reported by several investigators since Waletsky, *et al.* (*Jour. Parasit.*, 35:16, 1949) first published their findings. A recent paper by McGregor (*Jour. Am. Vet. Med. Assn.*, 118:394, 1951) confirms previous observations, but emphasizes a very important precaution that applies to the use of many drugs. This agent is successful only during the period of medication; there is no evidence of accumulation in the tissues.

When ANT was given at a 0.05 concentration in the feed for a period of two to six weeks to 13-week-old poults which were exposed to the infection, definite prophylactic action was noted as long as the drug was being administered. After the treatment was discontinued, clinical cases and deaths from the disease increased, but the number of cases declined in inverse proportion to the time that the ANT had been administered. The results reported by McGregor are encouraging in that they show that losses from the disease can be reduced by treatment, but they also emphasize again that treatment can only be considered an adjunct to standard preventive measures if maximum results are to be obtained.

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Officers of Auxiliary to the A.V.M.A.

Seated from left to right: Mrs. Charles C. Rife, Atlanta, Ga., treasurer; Mrs. H. S. MacDonald, Toronto, Ont., president-elect; Mrs. C. E. Bild, Miami, Fla., president; Mrs. Russell A. Runnells, East Lansing, Mich., first vice-president; Mrs. C. M. Rodgers, Blandinsville, Ill., secretary.

Standing from left to right: Mrs. L. R. Richardson, Revenna, Ohio, second vice-president; Mrs. Earl N. Moore, Trumansburg, N. Y., third vice-president; Mrs. A. E. Coombs, Skowhegan, Maine, chairman, House of Representatives; Mrs. Lewis H. Moe, Stillwater, Okla., Recorder, House of Representatives; Mrs. Dennis Coughling, Topeka, Kansas, *ex officio*.

North Central States Pullorum Conference

In September 1950, a group of workers in pullorum disease control met, upon invitation, at the Division of Veterinary Medicine, University of Minnesota, St. Paul, to discuss problems of pullorum disease control in chickens and turkeys.

The result was the organization of The Central States Pullorum Conference, which is to meet annually at locations in the various states of the region to work out ways and means of better pullorum disease control. The Conference is similar to that which has existed in the northeastern states for many years.

Representatives from North Dakota, South Dakota, Minnesota, Wisconsin, Michigan, Ohio, Indiana, Illinois, Iowa, Nebraska, Missouri, Kansas, and the BAI National Poultry Improvement Plan, met for the first official session of the group at Memorial Hall, Iowa State College, Ames, July 18-19, 1951. Coordination of work of those interested in this disease as a poultry industry problem is expected to result in a generally lowered incidence in this area of growing importance in baby chick, broiler and egg production.

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Equine encephalomyelitis (western) virus was isolated on three occasions by Sooter, *et al.*, from the circulating blood taken from nestling birds in Colorado. Miles, *et al.*, report isolation of the same virus from mites, *Dermanyssus americanus*, collected from wild birds' nests in the same region. These reports appear in *Proceedings of the Society for Experimental Biology and Medicine* for July 1951. Two additional articles appearing in the same issue also report virus isolation of eastern equine encephalomyelitis from a mosquito and a well-known marsh bird taken in Louisiana. These experiments are only part of an extensive search for the natural reservoirs of the virus of this disease.

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Horses on farms January 1, 1951, were estimated at 4,763,000 compared with 5,274,000 a year earlier. The present number is about 78% below the peak of 21,431,000 head reached in 1915.—*The Cattleman.*

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Several million acres of crops growing on rich soil of a half-dozen states in the Missouri-Kansas river bottoms were destroyed by the July floods.

To Make Extensive Foreign Survey

Dr. Ernest S. Tierkel, of Atlanta, veterinarian in charge of rabies control activities for the Communicable Disease Center, has begun a three months' tour of duty in Europe, Africa, and Asia under the auspices of the World Health Organization of the United Nations.

Dr. Ernest S. Tierkel

Doctor Tierkel is Assistant Chief of Veterinary Public Health Services for the Center, a division of the Public Health Service, Federal Security Agency. Since August 1950, he also has been a member of the Expert Panel on Rabies of the World Health Organization.

Overseas he will consult with public health authorities on rabies research and control activities. Making his base at the Geneva, Switzerland, headquarters of the World Health Organization, he first will be assigned to Northern Rhodesia and Southern Rhodesia, two countries in Africa which have requested his services.

Next, working out of Alexandria, Egypt, he will assist India and Pakistan and several countries of the Eastern Mediterranean region, including Iraq, Lebanon, Syria, Jordan, and Israel.

Doctor Tierkel will return early in January to resume certain rabies experiments he is conducting at the Communicable Disease Center virus laboratory at Montgomery, Ala.

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Hog number in Iowa set a new, all-time record, according to reports released by the Bureau of Census. On April 1, 1950, the total number of hogs and pigs on farms in Iowa was 10,716,220, or an increase of 3,000,000 head above the previous farm census taken on January 1, 1945.

The California Livestock and Poultry Pathology Laboratory was officially opened in ceremonies October 1, 1951 at Fresno.

The new laboratory, to be operated by the Bureau of Livestock Disease Control, Division of Animal Industry, California Department of Agriculture, is designed to fill the increasing need for animal and poultry disease diagnostic service. The laboratory will not perform services ordinarily expected of private practitioners. By means of early and accurate diagnosis reasonable assurance is given that prompt and effective action can be taken to reduce or eliminate epizootics that might otherwise prove costly to control.

Dr. W. W. Worcester will direct operations of this new facility.

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In citing experience with Johne's disease in England, K. D. Downham writes that the disease is largely one resulting from faulty dairy farm practices. He reports successful control in infected herds by instituting sound preventive methods of hygiene, nutrition and husbandry. He has also been able to effect recoveries in advanced cases by providing a good diet containing essential amino acids, vitamins and minerals. — *Brit. Vet. Jour.*, 107:309 (July), 1951.

"The term cat-scratch fever was coined by Foshay of Cincinnati for the disease characterized by a history of domestic cat scratches, followed by a systemic infection with malaise and fever in which the brunt of the infection is borne by the lymph nodes. The infective agent has never been isolated but is apparently a virus; it is present in the pus from lymph nodes involved and produces a specific skin reaction when made into an antigen. No specific therapy is yet indicated."—*Abs. Jour. Am. Med. Assn.*, 146:1261 (July 28), 1951.

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It may be that when more is known concerning the nutrition of rumen microorganisms we may have a helpful clue in solving the perplexing nature of ketosis and similar metabolism diseases of both cattle and sheep.—*Wise Burrough, Ph.D.*

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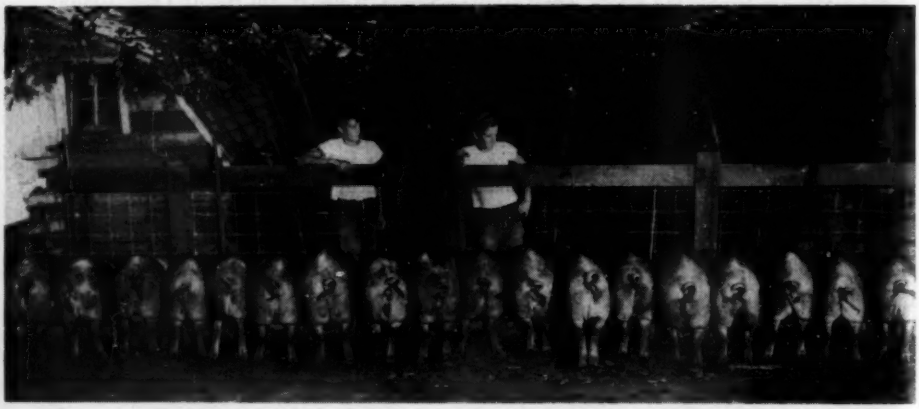
In view of reported findings by investigators and our own experience, it is believed definite or contributing causes of white muscle disease in calves and lambs are incompletely understood. Improved rations for dams during the last half of gestation, at present, offer the best means of prevention.—*L. R. Vawters, D.V.M.*

World's Heaviest Litter of Pigs



We are indebted to Dr. Walter A. Anderson, Hampton, Iowa, for supplying us with the photograph of a 4,419 lb. litter at 180 days of age.

This litter of 18 was the first farrowed by a fourth generation Farmers Hybrid gilt on February 20, 1951. Total litter weight at birth was 47 lb.

Jay and David Van Wert, 14 and 12 years of age (L to R), the owners, and nephews of Doctor Anderson, purchased four gilts for their club project. One of these produced the world's record heaviest litter shown above at the feed trough.

When farrowed, the pigs were separated into two groups. One group was allowed to nurse while the other group was fed a prepared formula. An hourly, alternating schedule was maintained day and night for the first four days, when the pigs were taught to drink from a trough and the time between feedings lengthened until the pigs were weaned.

PRINCIPLES OF ANIMAL HEALTH

R. R. DYKSTRA, D.V.M.
Manhattan, Kansas

In an article entitled Incidence of Trichinella Infections in San Francisco, 1950 (*Jour. Am. Med. Assn.*, May 26, 1951, the author states that, "Fifty-gram portions of diaphragms from 161 unselected autopsies done in San Francisco between November 1949 and June 1950, were examined for larvae of *Trichinella spiralis* by digestion with pepsin and hydrochloric acid. Thirteen (8%) contained parasites." This contrasts with 24% in 1936. The reduced number of infestations is attributed to the lessened practice of feeding garbage to swine, to education of the public so as to discourage the human consumption of raw pork, and more stringent regulations in the preparation of ready-to-serve pork products.

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Frozen orange juice is equal in nutritive value and ascorbic acid (vitamin C) content to the juice obtained directly from good grade oranges grown in proper soil and under correct climatic conditions, if it contains at least 40 mg. of vitamin C per 100 ml. of the frozen product. So long as it remains frozen or at least chilled, it maintains almost its entire original vitamin C, but after dilution of the frozen juice it rapidly loses vitamin C if kept in open containers at room temperature. Vitamin C is also plentiful in tomatoes, potatoes, raw cabbage, strawberries, cantaloupe, and various greens.

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Durrell, formerly a Lecturer in Animal Pathology at MacDonald College, Quebec, in the January 1951 number of the *Canadian Journal of Comparative Medicine*, reports on A Survey of the Role of Nutrition in Sterility in Dairy Cattle. Some of the conclusions are given as follows: (1) "A general low plane of nutrition was chiefly associated with the occurrence of anestrus and silent estrus in cows and heifers, and of impotency of bulls." (2) Much of it was alleviated by pasture indicating that unrecognized deficiencies existed, or "that grasses contain hormone precursors which are destroyed in the curing of hay or during the storage period." (3) Thus he advises, "Wider use of grass silage seems desirable." (4) A general conclusion is that "endocrine balance and natural resistance seemed to depend upon adequate nutritional support."

The Veterinary Public Health Service, Communicable Disease Center, Atlanta, Ga., reports that in an investigation of Q fever, a cow that had been "infected by or exposed to *Coxiella burnetii*", the causative agent in Q fever, and which had a "high complement-fixing antibody titer, yielded *C. burnetii* from the mammary gland and its regional lymphatics." The organism was not recovered from other cows in the project that had "a low level of complement-fixing antibody, or those with negative complement fixation reactions."

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This writer is not aware of any fact indicating that the virus of canine rabies is present in the saliva and other secretions of a dog more than five days preceding the onset of noticeable clinical symptoms. Therefore, we still hold to the opinion that if at the time the animal inflicts the bite it has no clinical evidence of rabies the welfare of the bitten person will be safeguarded if the biting animal is kept strictly confined for a period of two weeks for observation. All existing evidence seems to indicate that this is an ample margin of safety.

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A veterinarian has inquired: How may atrophic rhinitis be distinguished clinically from so-called "bullnose" of pigs? Bullnose of pigs is generally accepted as caused by facial wound infections with *Actinomyces necrophorus*. There is usually more or less necrosis and distortion of the facial region and snout because of granulomatous formations. On the other hand facial distortion is not necessarily present in atrophic rhinitis. Unthriftiness of affected pigs with slow growth may be the principal symptoms. Sneezing is frequent. Doyle, of Purdue University, states "pathognomonic lesions of atrophic rhinitis are found within the nasal passages. Partial or complete absence of the turbinate structures can be considered as diagnostic of this disease."

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Congress has been asked to appropriate funds for the purpose of attempting to exterminate halogen on ranges in the area where the plant has been responsible for large losses of sheep. (See *Vet. Med.*, 46:33 [Jan.], 1951.)

POULTRY PRACTICE PROBLEMS

W. R. HINSHAW, D.V.M., Ph.D.
Frederick, Maryland

Breed differences in heat tolerance of domestic fowl is discussed by two groups of investigators in the July 1951 issue of *Poultry Science*. In one of these (p. 477), Fox compares the heat tolerance of sexually mature White Plymouth Rocks and S.C. White Leghorns when exposed at 108 F. He found that the W.P.R. birds had a significantly longer average survival time than the S.C.W.L. birds with no sire, dam or sex differences. Wilson and Plaister (p. 625) exposed day-old New Hampshire and S.C.W.L. chicks to a temperature of 100 F. in closed chick boxes. They found that the N.H. chicks were more susceptible than S.C.W.L. chicks.

Fox investigated the effect of water consumption on the tolerance of the exposed birds and found that the survival time was increased by having drinking water available at all times. The survival time was associated with the persistency with which a bird continued to drink. S.C.W. Leghorns showed more inclination to drink at high temperatures than did heavy breeds (Rhode Island Reds and New Hampshire). The latter breeds had a tendency to cease drinking after short exposures. When no water was available, the mean survival time for S.C.W. Leghorns was 84.9 minutes in one trial and 89.7 minutes in another, as compared to 281 minutes when water was available. In contrast, the average survival time for R.I. Reds without water was 101.2 minutes and with water 150 minutes. No information was reported on W.P. Rocks.

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A case of human infection with *Salmonella saint-paul* following the eating of duck eggs is recorded by Clarenburg, *et al.* (*Nederland, Tijdschr, Genusk.*, 94:1615, 1950). *S. saint-paul* was isolated from the ovaries of two ducks from the flock that laid the infected eggs, and from other tissues of three other ducks. This is the second report from the Netherlands of such infection in man.

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So-called "sour" eggs, which are difficult to determine by the usual candling methods, can be detected with considerable accuracy by the use of black or fluorescent light. Sour eggs are caused by infection with Pseudomonas sp. which causes a green fluorescence in the albumin that is visible by black light.

It is time for my yearly reminder that one of the best bits of advice that you can give chicken and turkey raisers is to urge them to buy all their replacement chicks or poults from hatcheries that sell only chicks or poults from U. S. Pullorum Passed or U. S. Pullorum Clean stock. I also want to caution you once again that chicks or poults from U. S. Pullorum Tested or U. S. Pullorum Controlled Hatcheries cannot be guaranteed to be free from this disease. Lists of the available sources of U. S. Pullorum Passed and U. S. Pullorum Clean Flocks can be obtained from the National Poultry and Turkey Improvement Plans Agency in your state. Your County Farm Advisor's Office should be able to supply you with the address of this agency.

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"Freezer burn" in chickens, which is so often seen in birds frozen in home units can be prevented according to Vondell (Univ. of Mass., *Feathered Fax*, July 1951) by proper wrapping and use of a moisture and vapor proof wrapper. Locker paper. waxed on one side, is the cheapest and if the birds are not to be held longer than two to three months in the freezer, it is satisfactory. Aluminum foil and polyethylene bags are excellent when longer storage is planned.

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Research work done at Utah Agricultural Experiment Station (Bul. 343:7 [Dec.], 1950) indicates that young turkeys are more susceptible to DDT than are chickens when exposed to amounts usually used for dusting alfalfa for control of lygus bugs or weevil. In their trials, immature turkeys were killed by DDT level of 200 parts per million, while chickens fed the same level were unaffected.

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Diethylstilbestrol treated fryers will produce a highly significant gain over untreated controls during two weeks following treatment. This greater weight held during all the processing procedures, but when the birds were fried in deep fat there was a significantly greater loss in the treated as compared to the loss in the untreated birds. — *Poultry Sci.*, 30:512 (July), 1951.

PUBLIC HEALTH

JAMES H. STEELE, D.V.M., M.P.H.
Atlanta, Georgia

Salmonellosis

Following is a translation from German (Koller, R. Die durch Salmonellen verursachten bakteriellen Lebensmittelvergiftungen. *Wien. Tieraerztl. Mschr.*, 37:329, 1950) in which the author discusses the distribution of Salmonella infection in domestic animals in Europe and its transmission from animals to man both by contact and through food products:

"Every domestic animal and probably all vertebrates are potential carriers of Salmonellae. For Central Europe and Northwestern Europe, ducks and fowls are the most important carriers. The pig is the most important carrier among slaughter beasts. Cows can be carriers for years notwithstanding a low agglutination titer. Cow's milk has been repeatedly the cause of human salmonellosis. Cream, butter, ice cream and cheese can also be infected. Sheep are seldom carriers as contrasted with swine. Many types were isolated from commercial meat products, *e.g., S. typhimurium, S. give, S. derby, S. anatum, S. newport.* Salmonella infection of horses is also quite common. Infectious abortion of mares is caused by *S. abortus equi,* which is unknown among other animals. Young dogs, cats and other carnivore are very susceptible; adult dogs seem to be very resistant. Bacillary white diarrhea of chicks is caused by *S. pullorum; S. gallinarum* causes fowl typhoid; chicken meat can therefore give rise to the danger of severe food poisoning in man.

"Eggs and dried egg powder often contain all kinds of Salmonellae, *e.g., S. oranienburg, S. montevideo, S. meleagridis, S. tennessee* and *S. anatum.* Duck's eggs often contain *S. typhimurium* and have repeatedly caused bacterial food poisoning. The extensive dissemination of infection makes all projects to eradicate the Salmonellae from livestock hopeless. The best veterinary meat inspection is not sufficient to identify all Salmonella-bearing cattle and to keep them from infecting human beings. Therefore, only general zoo-hygienic measures and the most rigid exigencies of hygienic control in the meat industry will help effectively. Good results were seen from pasteurization of milk and meat products, and regular medical inspection of food handlers, water closets and wash-rooms in all food industries. Special care has to be bestowed on the small and medium industries, where sanitary conditions are neglected." — (Abs.: *Excerpta Medica,* 4:93 [Jan.], 1951.)

The problem of salmonellosis infection in the United States is not quite as serious as is outlined for Central and Northwestern Europe, but with the continuing investigations being carried on by public personnel, veterinary authorities are beginning to realize that a much bigger problem is presented than ever contemplated. The incidence of infection in dogs is quite amazing to those who have studied this problem in recent years. Investigations now being carried on in Southeastern United States indicate that some food animals coming to market are infected and that the meat products from these animals, especially sausages and similar meat preparations, are often heavily contaminated with Salmonella. The limited control that can be applied to this problem will have to be done largely by veterinarians in their practice inasmuch as these animals seldom become clinically ill. It may be that we do not understand the pathogenesis of this disease either in animals or man, and it is necessary for certain trigger mechanisms to be present to set off clinical disease. Continued investigation by public health teams and veterinarians may provide some of these answers in the near future. They certainly have demonstrated the wide animal spectrum of infection present here.

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Ringworm

Dr. W. L. Halverson, California Director of Health, reports approximately 80 cases of ringworm in school children in one county. Some were proved to be due to *Microsporon canis,* a common infection of domestic animal pets. Parents have been advised that ringworm exists in the school, that some of the cases are due to contact with infected dogs or cats, and that the animals should be sent to a veterinarian for examination as to ringworm infection. All veterinarians in the area offered free examination of pets.

This is a demonstration of the excellent public health assistance that veterinary practitioners can render to the community. Their services will be appreciated and long remembered.

VETERINARY PARASITOLOGY

A. O. FOSTER, B.A., M.A., Sc.D.
Beltsville, Maryland

A Safe, Effective Ascaricide for Cats

Because of the comparative intolerance of cats and kittens to many anthelmintic drugs, practitioners will have noted with interest the studies of Kanegis,[1] augmented by those of Colglazier and Enzie[2] on the use of diethylcarbamazine dihydrogen citrate (caricide®) against ascarids in these animals. In the aggregate, a dosage of 25 mg./lb. (50 mg./kg. in five cases and two doses of 25 mg./kg. in six cases) removed 98%, or 310, of 316 worms from 30 cats and kittens. The only side effects were occasional vomiting or, if capsules were chewed, excessive salivation.

Dogs are also good subjects for treatment with diethylcarbamazine, although the drug is not superior to other available anthelmintics for these animals.

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Studies on Horse Bots in Texas

A survey[3] of the occurrence of *Gasterophilus spp.* in the stomachs of 508 horses slaughtered near San Antonio, Tex., between February and August 1950, revealed almost universal infestation with an average of 226 bots per animal. Only three animals were free of these parasites and five had over 1,000 each. The largest number in one stomach was 1,659. Specifically, larvae of *G. intestinalis* outnumbered those of *G. nasalis* by a ratio of 61:39; *G. haemorrhoidalis* was not found. Six third-instar larvae did not appear to belong to any of these common species and their determination is pending.

In chemotherapeutic trials, lead arsenate at 5 mg./kg. was ineffective in two animals. This chemical had been suggested as a possible treatment[4]. Toluene, 20 cc./100 lb., on the other hand, suggested earlier by Todd and associates,[7] removed 259 bots from one horse, leaving only one specimen of *G. nasalis*. From another horse it removed 48 *G. intestinalis*, leaving one specimen of this species and three *G. nasalis*. This chemical appeared to be less injurious than carbon disulfide.

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Australian Measures against Blowflies

A pamphlet issued by the Joint Blowfly Control Committee, CCSIR, advised the use of 1% DDT or 0.05% gamma BHC for prevention of "body strike" in sheep. Body strike is defined as infestation starting "somewhere on the body, generally the shoulder, withers, back, or hips, as distinct from strikes that start on the crutch, tail, or pizzle."

It is recommended that application be made by spraying from pole to rump and halfway down the sides of the body using any suitable DDT or BHC preparation. Other methods, such as hand-spraying, shower-dipping, and swim-dipping are acknowledged as satisfactory, the last being preferred if sheep are being struck all over in severe fly-waves. It is advised that special attention be given to lambs, yearlings, and rams, and that DDT be used in preference to BHC for prophylaxis. Experimentally, under simulated rainy conditions and heavy exposure, 1% DDT gave complete protection for 54 days and 0.05% gamma BHC for 33 days. For preventing head strike in adult rams, either 2% DDT or 0.075% gamma BHC, applied thoroughly to the poll and base of horns, is recommended.

It will be recalled that other measures, notably mulesing, are commonly employed in Australia to prevent crutch strike.

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A report from France[8] states that aureomycin was of little or no value in experimental toxoplasmosis infections of rabbits but that terramycin checked the disease and permitted recovery of the animals. It is suggested that this may be the treatment of choice.

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[1]Kanegis, L. A., A New Treatment for Ascariasis in Dogs and Cats. *Jour. Am. Vet. Med Assn.*, 113:579, 1948.

[2]Colglazier, M. L., and Enzie, F. D., Notes on Caricide as an Anthelmintic for Cats and Dogs. *Proc. Helm. Soc. Wash.*, 18:50, 1951.

®Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

[3]Graham, O. H., and Alford, H. I., The Occurrence of *Gasterophilus spp.* in Texas and Some Tests with Insecticides for their Control. *Jour. Econ. Ent.*, 44:577, 1951.

[4]Radeleff, R. D., Lead Arsenate for the Removal of Bots. A preliminary report. *Vet. Med.*, 42:425, 1947.

[7]Todd, A. C., *et al.*, Action of Methylbenzene (Toluene) against Horse Bots. *Jour. Am. Vet. Med. Assn.*, 66:369, 1950.

[8]Girond, Paul and Gaillard, Jean-A, Action Comparées de la Terramycine et de l'Aureomycine sur les Toxoplasmoses. *Compt. Rend. Acad. Sc.*, Paris, 232:1457 (April 9), 1951.

CLINICAL REPORTS

Hoof Traction Splint

CLAYTON STEPHENS, D.V.M., Tupelo, Mississippi

Reproduction of the photograph below illustrates the use of hoof traction splint to effect repair of fractured left carpus. This method of splintage to immobilize fractured fragments and extend the leg has been employed on several cases with good result.

The patient, a three-year-old Jersey cow, suffered accidental injury resulting in a fracture of the carpal bone of the left carpus as determined by palpation.

The splint is made of 0.5 in. black pipe. The loop, top and side are one continuous piece. A short nipple at the bottom connects with the vertical pieces by two ells. Two small holes are drilled in the wall of the hoof in each toe below the sensitive lamina of the foot, and wire through these holes anchors the toes to the bar at the bottom of the splint. Note that a short piece of rope holds the upper circular crutch portion of the splint close by passing around the animal's body back of the shoulder. The leg is held securely so that there is no need for bandaging to the vertical shafts of the splint. The crutch portion of the splint is padded to prevent pressure necrosis.

Animals move around freely and appear not to object to the splint. When down, the leg is held straight in front. Patients have less difficulty in getting up from a sternal position than lying down, but are able to accomplish both immediately after application of the splint. This type of splintage has been found superior to plaster casts for reduction of fracture of the carpus, radius, ulna, tarsus and tibia. For reduction of fractures below the carpus or tarsus, plaster casting has given better results. Splints are removed in approximately three weeks.

Estradiol Cyclopentylate (E.C.P.) in Anestrus Mares

GORDON G. STOCKING,* D.V.M.
Pomona, California

During the 1951 breeding season, two purebred Arabian mares had gone considerable time without showing estrum.

One mare had foaled on January 16, and had a foaling heat ten days thereafter. Since 96 days had passed without evidence of heat demonstrated by teasing, 3 mg. of E.C.P.® were injected intramuscularly. At the end of ten days, treatment was repeated. There was still no outward response to medication. It was then decided to examine the mare twice a week to determine when she was in season. Twenty-two days after the second injection vaginal examination revealed a relaxed vulva, and a dilated, congested cervix. The mare did not show to the stallion, but on the 24th day (June 6), she was restrained and bred. Forty-five days after breeding, she was examined and found to be in foal.

The second mare, a four-year-old maiden, had not given evidence of heat since the breeding season started late in January. On May 4, 3 mg. of E.C.P. were injected, and on May 14, a dose of 5 mg. This animal did not respond to the teaser. Twenty-seven days after the second injection, vaginal examinations revealed signs of estrum, and on June 13, the 29th day after treatment, the mare was restrained and bred. Twenty-seven days later external signs of estrum were noted and the animal was rebred.

Neither of these mares showed to a stallion, even when they were found to be in season. Regular examinations were not made prior to the administration of this new estrogen which produced estrum in the approximate time expected.

Use with Gonadogen in a Bitch

Stark's Sumpin, a registered Greyhound bitch, 11½ years of age, was a good racing Greyhound and had produced a number of winners, one of which was Tropical Spice. Until two years ago this bitch was a regular breeder but had not shown estrum since that time.

On May 22, 2 mg. of E.C.P. were given

*Kellogg Unit, California State Polytechnic College, Pomona.

®The Upjohn Company, Kalamazoo, Mich.

intramuscularly. On May 27, swelling, reddening of the external genitalia was observed and on May 30 a definite vaginal discharge was noticeable. At this time, 20 C-N units of gonadogen®[1] were administered in an effort to stimulate ovulation. On June 7, 1951, when peak of heat was reached, she was bred and recently conceived a two-pup litter.

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Mal de Caderas or Severe Parasitism

DONALD W. BAKER,* D.V.M., Paraguay, South America

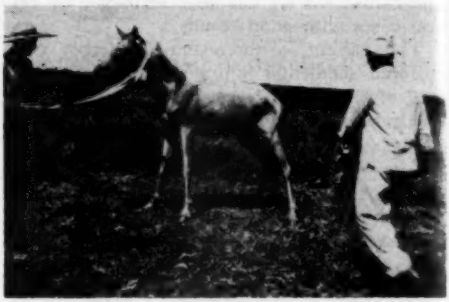
According to reports by veterinarians, livestock owners, and estancia managers in Paraguay, the most serious and prevalent disease of horses in this South American country is mal de caderas. Authorities on animal disease control here describe mal de caderas as a trypanosomiasis of horses, caused by *Trypanosoma equinum*, to differentiate it from mal de caderas of cattle, which is dumb rabies; the vampire bat acting as the vector and reservoir host.

A lumber company operating in the Sierra de San Joaquin region, using both horses and oxen, reported considerable loss from this disease. The writer was flown into the camp where a typical case was presented (see illustration). This was one of the last survivors of an affected group. The animal was on its feet, but weak and wobbly in the rear quarters.

Postmortem findings were interesting. In brief, the animal was the most heavily parasitized with helminths of many assorted kinds and sizes that it has been the writer's privilege to see. In addition to a dozen or more species of large and small strongylids, there was a fairly heavy infection of all three species of anoplocephaline tapeworms—the *Anoplocephala perfoliata* were especially numerous about the ileocecal valve. There was also a lungworm pneumonia with large numbers of *Dictyocaulas arnfieldi* in the smaller bronchi. Some pinworms were observed in the large intestine.

On opening the cecum and colon and discharging the fluid contents, it was observed that the entire surface of these organs was covered with the submucosal lesions caused by encysted strongylid larvae. There was no mystery in the cause of the chronic starvation or debilitation because the large intestine could not absorb food nutrients resulting from digestion in the stomach and small intestine.

A diligent search was made for evidence of trypanosomes, without success. Later, it was learned from Spanish textbooks that the proper technic for illustration of this blood parasite of horses is to inject the blood from a suspected case into an appropriate experimental animal and recover the parasite from such laboratory rodent. The fact which makes the



diagnostic procedure appear doubtful to the author is that this test animal is described in the same literature as the reservoir host of this blood parasite of the horse.

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On opening the glottis at autopsy of an aged Zebu cow, marked edema of all the tissue in the laryngeal-pharyngeal region was noted. Large numbers of attached blood red worms were noted and many small petechial hemorrhages. This strongylid worm is *Syngamus laryngeus*, found in Asia and Africa and lately reported from Brazil. Since this old cow came from Brazil it seems that fellow travelers accompanied the Zebu importations into that country, and that this parasite is now established in South America.

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It requires an average of from 4 to 5 lb. of feed to produce 1 lb. of gain in a turkey. The type of ration fed, the quality of the stock and the amount of green feed available, all influence this "feed-gain" ratio. As the turkey grows older, the ratio becomes greater, and at seven months of age, it requires as much as 10 to 12 lb. of feed to produce 1 lb. of meat.

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The total value of frozen poultry sold by grocery and meat stores in 1949-50 was $174,000,000. This value was one-third that of all frozen foods sold in grocery stores during the period.

®[1]Cutter Laboratories, Berkeley, Calif.

*Doctor Baker is assigned as Veterinary Parasitologist, Institute of Inter-American Affairs, Food Supply Division and stationed at Asuncion, Paraguay. The Institute is a portion of the President's Point Four Program.

Benadryl Hydrochloride in Treatment of Snake Bite in Dogs

H. K. MAIER, D.V.M., Beaumont, Texas

Snake bite, although not a problem in every section of the country, is of much concern in the South, Southwest and West. Numerous medicaments such as antivenom serum and potassium permanganate have been used in its treatment.

Snake venom contains hemorrhagin, a proteolytic poison which causes great local swelling and may lead to intravascular coagulation if the poison gets into the blood stream. Symptoms which result from the bite come on in a few minutes and consist of swelling around the bitten part, and later, collapse and peripheral circulatory failure if the venom enters the general circulation[1].

This report, on the use of steri-vial benadryl® hydrochloride, suggests the value of this antihistaminic agent in treatment of snake bite in dogs.

Case Reports

Three representative cases are cited:

Case 1. A three-year-old male mongrel weighing approximately 35 lb. was presented about an hour after having been bitten on the nose by a water moccasin. The animal's head was the size of a small watermelon. Temperature was 100 F. and the dog was markedly depressed. Since no antivenom serum was immediately available, 2 cc. of benadryl (sterile solution) for parenteral use containing 10 mg. benadryl per cc. was administered intravenously and the dog sent home. No other treatment was given. The following day the animal was normal. No further medication was necessary.

Case 2. A five year old male Wire-Haired Fox Terrier weighing 20 lb. was presented about 45 minutes after having been bitten on the right foreleg by a ground rattlesnake. Temperature was normal. Two cc. of sterile solution benadryl was administered intravenously followed by one 25 mg. kapseal benadryl hourly by mouth for six hours. The dog was taken home the next day apparently normal; however, tissue around the bite became gangrenous. Recovery was uneventful following local treatment of the wound.

Case 3. A six month old mixed toy terrier weighing 8 lb. was presented 45 minutes to one hour after being struck on the jaw by a ground rattlesnake. Temperature upon admittance was 101 F. One cc. of parenteral benadryl was administered intravenously followed by one 25 mg. kapseal benadryl hourly per orum for six hours. This dog was taken home the following day in apparently normal condition. Several days later, scabs came off the area of the bite following complete healing.

Conclusion

One to 2 cc. of benadryl hydrochloride solution (10 to 20 mg. benadryl) intravenously, as available in steri-vial benadryl, was a satisfactory therapeutic agent in treatment of three dogs bitten by poisonous snakes. Two dogs, struck by ground rattlesnakes were also given one 25 mg. kapseal benadryl hourly by mouth for six hours. Recovery in all cases was complete and dramatic.

REFERENCE

1. Kirk, H., Index of Treatment in Small Animal Practice, The Williams and Wilkins Company, Baltimore, 1948, p. 537.

®Parke, Davis & Company, Detroit 32, Mich.

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Atrophic Rhinitis Present in North Carolina Swine

J. CLARK OSBORNE,* B.S., M.S., D.V.M.,
Raleigh, North Carolina

During April 1951, two purebred Hampshire pigs, four months of age and weighing about 50 to 60 lb., were presented as representative of several animals similarly affected in a large purebred herd. The snouts were distorted and general unthriftiness was apparent. The manager stated that 20 to 25 animals exhibited similar distortion about the snout and face. Necropsy of the animals revealed a patchy red hepatization of the apical and cardiac lobes of the lungs with a suds-like material covering the lung surface. No gross pathology was seen in the liver and kidneys. There were many erosions (elongated and circumscribed) with dark margins on the mucosa of the cecum. Cross section of the nose revealed the pathognomonic lesions of partial or complete dissolution of the nasal turbinates, unilateral and bilateral.

History obtained on a visit to this herd revealed that this disease problem had been present in the herd for at least three years, with more "sneezers" (and nose bleeders) and distorted snouts showing up each succeeding year. Each year, several pigs were sent to slaughter at about 100 to 150 lb. when they failed to mature and finish after a feeding period ex-

*Animal Pathologist, Department of Animal Industry, North Carolina State College.

tending until pigs were eight to ten months of age. Several "sneezers" were observed among suckling pigs during the visit to the herd. Additions of valuable breeding stock, from points geographically covering the United States, had been made at varying intervals during the past four years. A diagnosis of atrophic rhinitis was made. It was recommended that the entire herd be sent to slaughter and that the premises remain open for six months before replacements were purchased.

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Red Water Disease in Feeder Cattle*

M. D. CONRAD, A.B., D.V.M., Plattsburg, Missouri

Red water disease in feeder cattle is an extremely acute, septicemic disease caused by the spore-forming, Gram-positive anaerobe, *Clostridium hemolyticum*. This anomaly is also known as icterohemoglobinuria and hemorrhagic disease. The name red water disease has been applied to various conditions affecting domestic animals, some of which are piroplasmosis, anthrax, and leptospirosis. It may be confused with hemorrhagic septicemia or even blackleg. Isolation and identification of the organism offer the only means of positive diagnosis.

Infection due to *Cl. hemolyticum* is characterized by sudden onset, rapid course, high temperature, bloody urine, and intestinal hemorrhage. One hundred per cent of cases are fatal after symptoms are observed.

Two toxic fractions are produced in cultures and in the animal body. One fraction is markedly hemolytic but is very unstable; the other has a necrotizing action.

No antigenic relationship exists between this organism and other pathogenic clostridia.

The condition has been reported previously in restricted areas of the southwestern and western United States. This report deals with a sporadic outbreak which occurred just 30 miles southeast of St. Joseph, Mo., in a herd of 200 Hereford steers. These animals were raised in New Mexico and were purchased in the spring of 1950 through an auction in the state of Kansas. It is believed that although this is not an endemic area for the disease, some lots of cattle, originating in the West, may develop the disease while being held in Missouri feed lots.

These cattle were grazed last spring and summer, then confined to dry lots and placed on a ration consisting of ground corn and cob meal, whole corn silage, soybean oil meal, salt, and mixed legume hay. The cattle were making excellent gains and the owner called in mid-November in reference to two steers found dead that morning. No symptoms nor illness were noted prior to finding them dead. Further questioning revealed that during the previous three weeks, four other steers had been lost in this herd. These two died suddenly, without symptoms. The two carcasses were carefully examined. Some edematous swellings were present in the dorsal lumbar region. Bloody discharges exuded from the nostrils and anus. Since the previous carcasses had been skinned and fed to hogs and the hogs remained healthy, anthrax was eliminated as a possible cause of death.

It was deemed advisable to immunize the entire herd with Clostridium chauvoei-septicus bacterin. While corralling the herd, one "slow" steer was noted as compared to the remainder of the herd which, incidentally, was a group of wild, big cattle to handle. Immunization procedures were completed and the "slow" steer was "chuted" for examination. By now, he seemed in a much more critical stage than when observed 2½ hours earlier. Temperature was recorded at 106 F., respiratory movements were shallow, sclera and conjunctiva were anemic, the animal was gaunt and was passing copious quantities of what appeared to be nearly pure shreds of clotted blood from the rectum. Penicillin in oil (3,000,000 units) was injected intramuscularly and a therapeutic dose of sodium sulfamethazine solution was given *per os*. The animal was dead within eight hours. A ligated ear, an unclotted blood sample from the jugular (blood was very dark, but still not clotted), and samples of the ensilage and hay were sent to a diagnostic laboratory. Findings were entirely negative.

No more deaths occurred for approximately three weeks; then two more steers were found dead. Autopsy lesions consisted of marked and extensive subcutaneous and subserous hemorrhages in the parietal peritoneum and mesentery, petechial and ecchymotic hemorrhages in all the viscera and tissues, large quantities of hemoglobin-stained fluid in body cavities, port-wine colored fluid in the urinary bladder, gall bladder distended with dark, greenish-yellow bile, perivascular hemorrhages in pleura and peritoneum, light colored multiple infarcts in liver (the large hemorrhagic infarct which is said to reach four or five inches in diameter and which is supposed to be pathognomonic of the disease was not noted), liver necrosis, spleenic enlargement, severe hemorrhagic enteritis and colitis, intestinal mucous membranes

*Presented at the 61st annual meeting, Missouri Veterinary Medical Association, St. Joseph, Mo., June 26, 1951.

undermined, and extensive hemorrhages and masses of clotted blood and mucosal linings found in the colon and rectum. Viscera were taken to a diagnostic laboratory.

Microscopic examination of intestinal contents was entirely negative for coccidial oocysts. A stained smear prepared from liver tissue revealed Gram-positive, spore-bearing rods with the spores located subterminally. The organisms definitely resembled those of the Clostridium group.

Formolized and refrigerated liver tissue was sent via air mail to the Pathological Division of the Bureau of Animal Industry in Washington, D.C., for histological study and confirmation of the tentative diagnosis of *Cl. hemolyticum* infection. The herd was injected the next day with red water bacterin.

Approximately six weeks later, a confirmative diagnosis of red water disease was received from Washington, stating that histological examination of the liver showed typical lesions and organisms.

Positive bacteriological confirmation of the disease by animal inoculation was not possible since, as stated before, the pathogenicity for laboratory animals depends on the powerful hemolytic toxin being present in high concentration along with the organism itself.

Approximately two weeks following immunization, two more steers were found dead.

The red water bacterin is a formolized bacterin adsorbed on aluminum hydroxide and is believed to confer immunity of several months' to one year's duration. Its percentage of effectiveness is unknown. This herd has not suffered any death loss due to red water disease during the past four months and most of the herd is now ready for slaughter.

It is believed that the red water bacterin effectively stopped losses. The disease is one primarily affecting cattle in the southwestern regions; animals grown there can graze infected pastures and harbor the organisms till they reach local feed lots; and then, after suitable and favorable conditions present themselves, the Clostridium may gain a foothold to produce fatal infections.

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Value of 1951 Pig Crop in Illinois

The 1951 Illinois pig crop is valued at more than a quarter of a billion dollars by the Illinois State Department of Agriculture, who are the authority for the statement that there are 6,976,000 hogs on Illinois farms, worth about $252,000,000.; an increase of $60,000,000. over 1950.

Relationship and Duties of Practitioner and Student Assistant

Veterinary students have come to look forward to opportunities for association with practitioners during summers between college sessions. Such on-the-job training activity has gained tremendous impetus and the favorable relationships from the standpoint of practitioner and student forecast participation of even greater numbers of veterinarians in future years.

The Education Committee of the American Animal Hospital Association has devoted study to ways and means of making summer employment with a practitioner of benefit to both parties. From its work, the Committee recently expressed its views after interviewing participating employers and employees. The following report was given general mailing to all members of the A.A.H.A., with a request for comments in the hope that a manual might be prepared which would serve as a guide.

The Practitioner

A practitioner should not consider hiring a student unless the practice will afford ample opportunity for the student to spend the greater part of his time working with patients. A student should expect to assist with porter work and other menial tasks, provided this does not consume his day. Sufficient time must be provided for him to see and work with patients. The primary purpose of association is to gain experience with veterinary problems.

The practitioner should realize that the student trainee is well grounded in basic sciences, but limited in clinical knowledge, training and experience. The crowded curricula of veterinary schools leave little time for adequate application of the training received in business psychology, hospital and office methods, hospital maintenance, sanitation, and humane handling of patients. Care should be taken in assigning work schedules to see that the trainee has an opportunity to gain experience in all these subjects. In the summer months, the volume of practice increases; therefore, the trainee can best act as an extra pair of hands in all departments as the occasion demands, rather than being employed specifically as a replacement for a regular employee.

To enjoy the fullest cooperation, there should be frank discussion, before employment, of the work schedule, including hours, time off and salary. When this has been agreed

(Continued on page XXII)

ABSTRACTS OF LITERATURE

Vesicular Stomatitis Transmissible to Man

Three cases of human infection with the virus of vesicular stomatitis (V.S.V.) occurring during the course of animal experimentation at the University of Wisconsin[32] have been confirmed by high neutralizing activity of the sera of recovered patients for V.S.V. The virus was not isolated. This report suggests that another animal disease communicable to man may be added to a long and important list of such diseases.

A strain of vesicular stomatitis virus was isolated from an infected cow in October 1949. The virus has been maintained by serial passage in embryonating eggs. Intradermal inoculation induced swelling and reddening of the foot pads in guinea pigs and intracerebral injection in mice was followed by death. Characteristic lesions, vesiculation, maceration, sloughing of mucosa, elevated temperature, inappetence, and rapid weight loss were produced in cattle by inoculation of the egg passage virus into the oral mucosa.

Confirmed reports of human infection have not been found in the literature, though the virus of this disease was suggested as the cause of illness as early as 1917.

Of the three members of the laboratory staff affected, the first handled four experimentally infected heifers in the initial stage of their illness; the second, handled the same animals on the same days as did the first man; and the third person was spattered with virus-containing material while harvesting infected allantoic fluid.

The onset of the disease was rapid and the incubation period short (30 to 48 hours). Muscular pain developed in the legs and back. Other symptoms included headache, malaise, chills and fever. All patients recovered under non-specific therapy. In all, sera obtained after recovery indicated high titer of neutralizing antibodies to V.S.V.

These observations support prior reports that the virus of vesicular stomatitis is transmissible to man under naturally occurring conditions, and that infection of animals with this virus is of public health significance.

[32]Hanson, R. P., Rasmussen, A. F., Jr., Brandly, C. A., and Brown, J. W., Human Infection with the Virus of Vesicular Stomatitis. *Jour. Lab. & Clin. Med.*, 36:754 (Nov.), 1950.

Complement Fixation Test for Tuberculosis[33]

It has been estimated that the intradermal test fails to detect tuberculosis in about 1 to 5% of cases. This article examines the possibility of the use of the complement fixation test as a supplement to the intradermal test. The experiment compares the efficiency of the complement fixation test in relation to; (1) results obtained through the intradermal test and lesions found on meat inspection; (2) results obtained by provoking a reaction by injecting tuberculin; and (3) results obtained by using the complement fixation test where there are disputes over the validity of the intradermal reaction. In all, 600 sera were examined; using three different technics, with a total of 1,200 analyses.

The complement fixation test had an efficiency of 80% in detecting infected animals, as compared with at least 95% for the intradermal reaction. Some animals with no lesions and negative intradermal reactions did give positive complement fixation. It was also observed that animals found negative to intradermal and ophthalmological tests would react between the third and tenth days after tuberculin injection and the positive serological reaction was maintained for one month.

It is concluded that while the serum of an animal with localized tuberculosis does not always show a positive complement fixation, the case of generalized disease will most always give a positive reaction.—*M.A.S.*

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Wright has been successful in isolating a strain of *Salmonella pullorum* which contains the complete antigenic formula IX, XII, XII_2, XII_3 with which he has been able to produce a satisfactory single tube antigen. An antigen produced with this strain will detect carriers of both the so-called standard type of *Sal. pullorum* (IX, XII, XII_3) and the XII_2 variant type (IX, XII, XII_2). The discovery of such a strain will be welcome to all testing laboratories that have had to resort to two tests using separately antigens containing the IX, XII, XII_2 and IX, XII, XII_3 types of strains of *Sal. pullorum*.

[33]Debrot, S., Essais D'Utilisation de la Deviation du Complement dans le Diagnostic de la Tuberculose Bovine. *Rev. de Path. Comp.*, 51:3 (Jan.), 1951.

Dogs and Cats Are Not Color-Blind

Repeatedly the statement is made that all dogs are color-blind. Professor Schubert,[24] an outstanding expert, states that dogs are not color-blind; that with the help of Pawlow's reflexes one can prove that these animals distinguish not only colors, but even color shades. But it is not clear, as yet, whether they are able to distinguish all colors in the same way that human beings do. The retina of cats, as shown by electrophysiologial studies, is sensitive for the spectrum colors ranging from red, through green, to blue. Cats and dogs have retinas of the same functional types, so-called E-retinas.

A dog's vision is not as strong as that of a human being even though its eyes possess a similar accommodation mechanism. However, it is wrong to assume that the dog sees stereoscopically bad; like man, he has a two-eyed visual field, which is the important point.—*R. S.*

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Virus Encephalomyelitis of Swine

Detailed pathological study of brain and cord lesions in swine infected with Teschen's virus is the subject of a report by American virologists with the U. S. Army in Germany[27].

Material studied consisted of brain and cord specimens collected from six pigs, four to six weeks of age, infected intracerebrally with a suspension of virus supplied by workers in Prague. Animals began to exhibit symptoms on the sixth postinjection day. Onset was accompanied by fever; followed, in order, by stiffness, ataxia, tremors, spastic convulsions, nystagmus, cranial nerve palsies, weakness and paralysis of the extremities, and in the majority of cases, death.

Microscopic study of sections through the brain and spinal cord reveal the disease to be a diffuse encephalomyelitis with characteristic lesions. Their widespread distribution in the central nervous system distinguish Teschen's disease from poliomyelitis, although spinal cord lesions may be similar. Pathologically this disease resembles Japanese B encephalitis and louping ill.

[24]Schubert, G., The Color Sense and Strength of Vision of the Dog. *Wiener Tierärztl. Monatsschrift*, 37:127 (Feb.), 1950.

[27]Horstmann, Dorothy M., Manuelidis, Elias, and Sprinz, Helmuth, Neuropathology of Teschen Disease (Virus Encephalomyelitis of Swine). *Proc. Soc. Exp. Biol. Med.*, 77:8 (May), 1951.

Artifical Insemination in France[29]

The absence of veterinarians in some of the insemination centers is detrimental to the future of artificial insemination in France.

The examination of the bull's sperm is divided into three parts: (1) macroscopic, (2) microscopic, and (3) biochemical.

(1) Macroscopic. (a) Volume measured by collecting in a graduated centrifuge tube, varies from 1 to 10 ml. with 4 ml. average. (b) Color and consistency—the thicker the product, the more the concentration of sperm.

(2) Microscopic. (a) Motility test made at a temperature of 37-40 C. under low power, in blood cell counting chamber and seen as a series of moving waves. (b) Sperm count made in chamber; heads are counted. The variation is 500,000 to 2,000,000; average, 1,000,000. Absence of sperm can be found in bulls showing no clinical signs. (c) Staining and examination for abnormal forms. Abnormal forms consist of immature forms, tailless forms, abnormal tails, malformed heads, double heads, abnormal intermediate piece.

(3) Biochemical. (a) Methylene blue test; over ten minutes for decoloration is considered poor. (b) Measure of pH. between 6.2 to 6.6 is normal.

Technics and interpretation of these tests are discussed. Each individual test means little. Information is gathered from the results of the ensemble.—*M.A.S.*

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British Experience with S. 19 Brucellosis Vaccine

An attempt was made to control the spread of *Brucella abortus* in a dairy herd by blood testing and disposal of reactors. This met with no success and it became necessary to vaccinate all the cows, including pregnant animals, with S. 19 vaccine.

Five cases of *Br. abortus* infection were detected at parturition from 42 animals vaccinated at a mean gestation period of 5.7 months. Four of these five strains were apparently field strains, but the fifth strain was aerobic, sensitive to thionin, and similar to S. 19 in virulence for the guinea pig. Our experience indicates that the risk of abortion due to vaccination of pregnant cattle with S. 19 *Br. abortus* vaccine appears to be slight.—*A. McDiarmid, M.R.C.V.S., Ph.D.* in *Vet. Rec.*, 63:15 (Apr. 14), 1951.

[29]Theret, M., Insemination Artificielle: Technique d'examen du sperme de Taureau. (Artificial Insemination: Technic of Examination of the Bull's Sperm.) *Rec. de Med. d'Alfort*, 126:749, 1950.

Therapy in Swine Dysentery

In an outbreak of swine dysentery or a clinically indistinguishable disease, the drove was divided into six groups to study results of chemotherapy.

Percentage of recoveries of those treated with sulfonamides was not significantly greater than the controls[24]. Sodium arsanilate gave better results but symptoms of unthriftiness continued. Of 26 animals which received six consecutive daily doses of 100,000 units of bacitracin, only one animal died. Of 20 pigs that received 50,000 units of bacitracin daily for six days, only four died. Survivors in both groups treated with the antibiotic exhibited marked clinical improvement.

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Response to Formol Inactivated Virus—Anavirus

The paper[25] reviews results of the recent work of the authors on the elaboration in the horse of specific antibodies in response to the injection of formol inactivated vaccinia virus and aphthous fever virus. These inactivated viruses are called "anavirus" and comparisons are drawn between immunity with anatoxins and anaviruses.

By means of the use of vaccinia anavirus there was observed, in the horse, the appearance of antibodies in five days after the first injection and a highly active neutralizing antiserum in one month. The neutralizing power of the antiserum against the vaccinia virus has been demonstrated *in vivo* and *in vitro*. Anavirus is equally as effective as active virus in provoking specific antibodies in the horse. The work was extended to provoking an aphthous fever neutralizing serum by use of foot-and-mouth anavirus.

Anavirus is entirely innocuous and the authors state that antibodies can be provoked by an inactive virus, and infection is not necessary for virus immunity. They state that in cases where immunity to virus infection is demonstrated without finding humoral antibodies, it is because they are present in too low a level to be measured by present methods.

[24]Boley, L. E., Woods, G. T., Hatch, R. D., and Graham, Robert, Studies on Porcine Enteritis II. Experimental Therapy with Sulfathalidine, Sulfamethazine, Sodium Arsanilate, and Bacitracin in a Natural Outbreak of Swine Dysentery. *Cornell Vet.*, 41:231 (July), 1951.

[25]Ramon, G., Thiery, J. P., and Richou R., A Propos de la Preparation d'un Serum Anti-vaccine et d'un Serum Anti-aptheux au Moyen des Anavirus Correspondants. (1949).

Salmonellosis in the Mare

Salmonella abortus equi in the mare causes a premature expulsion of the fetus from the seventh to tenth months of gestation[26]. The disease also manifests itself as a pyosepticemia in the foal. It is on the increase in France and other parts of Europe.

The author describes work that indicates that the organism is capable of causing general or local disease (arthritis, abscesses, orchitis, paresis, paralysis, septicemia and others) in horses of all ages and both sexes. Abortion is only one expression, though probably the most frequent, of Salmonella infection in horses. The author does not believe that there was at that time (1949) any agent capable of curing the disease. Penicillin was not effective and tests were recommended using streptomycin, aureomycin and chloromycetin. In human pathology, the organism was found in the stool of a man sick from eating meat of an affected animal, which had been emergency slaughtered.—*M.A.S.*

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Leukemia in the Dog[27]

In a discussion of the disease, it is stated that breed plays no part, that it is most frequently seen in animals over four years of age, and that the sex role is problematic. Etiology is unknown. Three types are recognized; (1) lymphoid, (2) myeloid, (3) monocytic. Most cases show only a few changes in the circulating blood, *i.e.*, aleukemia. The changes are seen in the tissues. The lymphoid form is the most frequent and the monocytic is rare.

The case observed exhibited symptoms as follows; loss of appetite, diarrhea, loss of weight, slight elevation of temperature, feeble rapid pulse, non-painful enlargement of the abdomen, and a hypertrophic spleen. External lymph glands were normal, RBC down, and WBC at 170,000 per ml., with the appearance of many lymphocytes and lymphoblasts. The course of the disease was only 15 days and autopsy showed hypertrophy of the spleen. Mediastinal and mesenteric lymph glands were soft and enlarged.—*M.A.S.*

[26]Verge, J., Le Role de *Salmonella abortus equi* en Nosologie Humaine et Veterinaire. *Rev. de Path. Comp.*, 49:643 (Dec.), 1949.

[27]Robin, V., and Charton, A., Sur un Cas de Leucose Lymphoide du Chien. *La Revue de Pathologie Comparee*, 603:93 (Jan.), 1949.

BOOK REVIEWS

Books reviewed in this department and any other books, if available, may be obtained by remitting the published price to the Book Department, Veterinary Medicine, Suite 803 Livestock Exchange Building, Kansas City 15, Missouri.

THE MINK IN HEALTH AND DISEASE, by *Arnold H. Kennedy,* B.S.A., D.V.M., D.V.Sc., Head, Department of Fur Bearing Animals, Ontario Veterinary College, Guelph, Ontario, Canada. 307 pages, illustrated. Fur Trade Journal of Canada, Toronto, Ontario, publisher, 1951.—Price $6.50.

This book is the first ever published on mink diseases.

Too few veterinarians working with diseases of animals have given time and attention to the observation and study of disease conditions affecting fur bearing animals. Practitioners are encouraged to inform themselves of the diseases to which these animals are subject. The industry, now on a sound economic level, is cognizant that diseases may be limiting factors in profitable fur farming.

The book does not follow the pattern of textbooks on pathology, but considers those anomalies, under separate headings, observed by the author in his work. Material is strictly to the point; considering cause of the abnormal condition observed and its prevention and treatment. In view of many difficulties presented in the treatment of mink, preventive medicine is given the emphasis it deserves. In this field, the informed practicing veterinarian can render fur farmers a worthwhile service.

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CANCER AS I SEE IT, by *Henry W. Abelmann,* M.D. 100 pages. Philosophical Library, New York, publisher, 1951.—Price $2.75.

This little book develops the theory of the germ-virus nature of cancer. By germ-virus, the author explains that the organism has the ability to assume the character of a germ in one instance and a virus in another. This parasitic theory of invasion following devitalizing factors, that may reduce cellular resistance, is claimed to be an important truth essential to cancer progress.

Importance of frequent physical examinations and keeping oneself in the best possible state of health and nutrition is advice offered to reduce fatalities that result from advanced cancerous processes.

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Turkey Raising.—Revision of popular bulletin by S. T. Marsden.—USDA Farmers' Bul. F 1409.

INSECT CONTROL BY CHEMICALS, by *A. W. A. Brown,* M.B.E., B. Sc. F., M.A., Ph.D., Professor and Head of the Department of Zoology, University of Western Ontario, London, Canada. 817 pages. John Wiley & Sons, Inc., New York, publisher.—Price $12.50.

The publication of this book is especially timely since it organizes the information that has been so rapidly accumulating since the end of World War II. The number of mid-twentieth century compounds shown to have insecticidal properties is imposing. These are grouped for discussion into six classifications: chlorinated hydrocarbons, organic phosphates, botanicals, inorganic compounds, fumigants and dusts.

Little of the text material specifically treats parasites of animals, though these are included in the discussion of how various groups of agents are toxic to insects.

Tracing the connection between the molecular structure of many of these chemicals and their toxicity to insects, plants, and animals highlights the technical discussion, as does the section dealing with the pharmacology of poisons.

For the reader interested in essential facts on the chemical, physical, and toxicological aspects of agricultural insecticides and matters pertaining to economic entomology, this book contains the latest data presented understandably.

An exhaustive reference list appends each section of the book; a total of 2,300 are given.

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Listeria infection in a canary and a chicken are reported by Biglund (*Canad. Jour. Comp. Med. & Vet. Sci.,* 14:319, 1950) from separate premises in Alberta, Canada. In neither instance were other birds involved. *Listeria monocytogenes* was isolated from each case.

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VETERINARY ITEMS OF INTEREST

Vitamin A deficiency is an important factor in the formation of cystic calculi.

A record low maternal death rate is estimated at 7.2 deaths in 1950 per 10,000 live births.—*S. N. L.*

I have found that when cows can be fed on a vitamin-rich diet, the death rate in calves can be lessened.—*A. S. Chapman, Vet. Rec.*

A rumen microorganism, not yet completely identified, is reported by a group of chemists to produce a mixture of cobalt-containing compounds said to be precursors of vitamin B_{12}.

Total value of furs imported in 1950 by the United States from Russia and her satellites amounted to 45,954,174.; 45% of all U. S. fur imports.—*Fur & Market Jour.*

Over 800 cases of malaria among military personnel returning from Korea have been reported by state health authorities in recent weeks, according to report by the Surgeon General of the Public Health Service.

One injection of 10 cc. of a 5% formalin solution intravenously proved to be an effective hemostatic agent in dogs. Gonzaga (*Ind. Vet. Jour.*, 27:411 [May], 1951) states that this treatment produces no permanent ill-after-effects.

Though confined largely to grade herds, artificial insemination of purebred dairy cattle is increasing. The *Milking Shorthorn Journal* reports that 17% of all registrations of the six dairy breeds, including Milking Shorthorns, were animals resulting from artificial insemination.

More than 26,000 students were enrolled in 79 medical and basic science schools of the United States during the 1950-51 school term; an increase of 4.1% over the number reported for the previous year. During this period 6,135 physicians were graduated.—*Jour. Am. Med. Assn.*

We spend money through pipe lines for war and through eye droppers for welfare and security.—*L. W. Wirth.*

Among 605 men with bronchiogenic carcinoma, other than adenocarcinoma, 96.5% were moderately heavy to chain smokers for many years.—*Jour. Am. Med Assn.*, May 27, 1950.

Legislation is pending, directing the government to pay $39,727. to an Illinois fur farmer for alleged losses in mink production due to feeding poultry wastes recommended by the USDA.

Terramycin, one of the new antibiotics, is said to be active against the etiological factors of such conditions as Q fever, Rocky Mountain spotted fever, gas gangrene, amebiasis, pneumonia and others.

Molasses, glucose, etc., are antagonistic to the action of sulfonamides. Therefore, in the administration of these chemical compounds by mouth do not include any of the sugars in the haustus.

Rape and sudan grass fed to laying hens may cause them to lay eggs of an inferior quality. Goodman (Ala. Agr. Exp. Sta. 58th and 59th Ann. Repts.) made these observations and also found that 43% of the eggs laid by hens grazing on these crops had olive-green yolks.

Public health records in the United States indicate that for the period extending from 1917 to 1950, there was a decrease of approximately 85% in the death rate in men due to extrathoracic tuberculosis. Much of this may be credited to the virtual stamping out of bovine tuberculosis.

Chloroquine diphosphate, an antimalarial compound, recently has been reported as an effective remedy in the treatment of a case of amoebic hepatitis. In experimental rats, the compound is said to be stored preferentially in the liver. Some animal disease researcher might try its effect in the handling of bovine fascioliasis.